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COURTS CRAMP N. L. R. B.

Analysis of the Federal Court decisions affecting its actions shows that its scope is being narrowed, and indicates the possibility that it may be repealed as innocuous. The final word has not been said, however, because no cases have been passed upon by the Supreme Court

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RECENT decisions in the United States Circuit Court of Appeals interpreting the National Labor Relations Act are of considerable significance. From these one is compelled to conclude that even if the Act is ultimately held to be constitutional, about which there is considerable doubt, it will be so restricted in its scope that it will gradually become innocuous, or be repealed. Of course, these decisions are not final as they are all subject to appeal to the Supreme Court of the United States; nevertheless they give a fairly good cross section of judicial thinking, which is largely based upon pronouncements of the highest court in earlier cases involving the same broad principles as are involved in the cases dealing with the National Labor Relations Act. Most of these decisions are in cases dealing with the question as to whether or not certain types of business activities come within the legal conception of transactions within or directly affecting interstate commerce, since it is universally accepted that only such activities may be subjected to the provisions of the Act. These cases have arisen as a result of the attempt of the National Labor Relations Board to secure enforcement of orders issued by it pursuant to the Act.

In the case of the Jones & Laughlin Steel Corporation, decided on June 15 in the United States Court of Appeals for the 5th Circuit, the National Labor Relations Board petitioned the court to enforce an order requiring the steel company to reinstate certain discharged employees and to do other things in that connection. The company contended that since the employees were engaged in a manufacturing operation, the Act did not apply. The Court in upholding the contentions of the steel company cited the decision in Carter vs. Carter Coal Company rendered on May 18, 1936, by the United States Supreme Court.

On June 30, 1936 the United States Circuit Court of Appeals for the 6th Circuit decided the case of the Fruehauf Trailer Company, and held upon the authority of the Carter case and also the Jones & Laughlin case that the Act did not apply to activities conducted in connection with the manufacture and production of trailers. It should be noted in this connection that trailers are articles manufactured for possible use in interstate commerce, but this fact was apparently considered of no importance by the court. The rule that manufacture and production is not interstate commerce seems so well established that it makes no difference whether the particular article manufactured is designed to be used in interstate commerce, (for instance, a locomotive) or otherwise.

Another case involving the scope of the Act is the case of the National Labor Relations Board vs. Friedman-Harry Marks Clothing Company, Inc., decided in the United States Circuit Court of Appeals, 2nd Circuit, on July 13, 1936. In that case the Board petitioned the court for the enforce-

ment of an order directing the company, a clothing manufacturer, to desist from certain unfair labor practices in discharging and discriminating against employees engaged in union activities. The court held that the orders of the Board were unenforceable as the practices complained of were not in interstate commerce and did not directly affect interstate commerce and therefore were not within the scope of the Act. In this particular case the government argued that raw materials used in the manufacture of clothing were shipped to the company in interstate commerce; that the manufactured clothing was later shipped in interstate commerce and that the intermediate step of fabricating the clothing was but one of a continuous step in the flow of commerce; that therefore under the "flow of commerce" doctrine enunciated in the Swift Packing Company case, decided some years ago by the United States Supreme Court, this brought the particular process of manufacture within the field of interstate commerce. The court rejected this theory as applied to the manufacture of clothing from raw materials. In the Swift case, where livestock was consigned and delivered to the stockyards, not as a place of final destination, but as a "throat through which the current flows", it was held that the activities at the stockyards were in interstate commerce. It is obvious that if the court had in the Friedman-Harry Marks Company case applied the "flow of commerce" principle of the Swift decision contended for by the government, the activities of any companies engaged in the fabrication or processing of goods from raw materials designed for interstate shipment would be considered as coming within the Act on the theory that fabrication or processing is a mere step in the flow of commerce. The decision in the Friedman-Harry Marks case seems to shut off definitely any chance of expanding the "flow of commerce" principle so as to take in manufacturing and processing.

Board Wins Case

In one case the Board has scored a rather notable victory, that is, the case of the Associated Press, decided by the United States Circuit Court of Appeals for the 7th Circuit on July 13, 1936. In that case the Board petitioned the court to enforce an order issued pursuant to the Act. The Board had ordered the re-instatement of one Watson, who had allegedly been discharged because of his membership and activity in the American Newspaper Guild. Watson was employed in an editorial capacity as a member of the News Department. He was engaged in the revision or rewriting of news coming in over the wires prior to its distribution and filing as outgoing news. The Associated Press contended among other things that Watson was not engaged in interstate commerce or in any activity directly affecting interstate commerce and therefore the Act did not apply. The court rejected this theory and held that the business of gathering and distributing news is interstate commerce and that furthermore a labor dispute affecting the rewriting staff might cut off interstate and foreign receipt and transmission of news. The court therefore held that Watson should be reinstated. This decision adopts the principle of "flow of commerce" in the Swift case. However, the Associated Press case is clearly distinguishable from the Friedman-Harry Marks case in that the transmission of news through the medium of an agency such as the Associated Press is an activity in interstate commerce, and the rewriting of such news is one in a series of continuous steps in the distribution of the news, but in the case of the manufacture of clothing, the manufacturing operation is entirely separate from the movement of raw materials and subsequent shipment of the finished product.

Application Appears Wide

If the Associated Press decision is sustained by the Supreme Court of the United States, it would seem that the Act could be applied to any activities bearing upon the transportation of goods or intelligence, such as the activities of salesmen selling goods for shipment in interstate commerce, the activities of those in the shipping departments of companies selling goods for shipment in interstate commerce, and possibly the activities of editors of newspapers and magazines. Nevertheless, the scope of the Act would be rather restricted, and it is doubtful whether its continuance would be justified. The decision in the Associated Press case upholds the constitutionality of the Act.

Two cases in the United States Circuit Court of Appeals involving the question as to whether a majority vote of all eligible employees in a particular craft is necessary, or whether merely a majority of those voting is necessary in a labor election, hold that a mere majority of those voting is sufficient. The cases in question are those of the Virginia Railway Company, decided on June 18, 1936 by the United States Circuit Court of Appeals, 4th Circuit, and the case of the Association of Clerical Employees of the Atchison, Topeka & Santa Fe Railway System vs. the Brotherhood of Railway and Steamship Clerks, etc., decided in the United States Circuit Court of Appeals for the 7th Circuit on July 8, 1936. It should be noted, however, that these cases are under the Railway Labor Act. The language in the Railway Labor Act governing this question is as follows:

> **"The majority of any craft or class of employees shall have the right to determine who shall be the representative of the craft or class for the purposes of this 'chapter'."**

The National Labor Relations Act provides as follows:

> **"Representatives designated or selected for the purposes of collective bargaining by the majority of the employees in a unit appropriate for such purposes, shall be the exclusive representatives of all the employees in such unit for the purposes of collective bargaining in respect to rates of pay, wages, hours of employment, or other conditions of employment."**

As the language used in the two Acts is not essentially different insofar as the particular question is concerned, it is likely that courts which have ruled in the cases involving the Railway Labor Act would rule similarly on this question in a case involving the National Labor Relations Act.

Summarized briefly, while there have been some important decisions under the Act, no cases involving a substantial question have been passed upon by the United States Supreme Court. This is particularly true insofar as the question of constitutionality of the Act is concerned. As a matter of fact, it is extremely difficult to glean from the decisions of the United States Circuit Court, with the possible exception of the Associated Press case, a definite and positive view on the question of constitutionality. It is, however, fairly clear that the scope of the Act will be restricted to those activities which are essentially interstate commerce in nature, or directly affecting interstate commerce and that it will not be applied to production or manufacturing processes. It also seems clear that certain activities within organizations which are engaged in production or manufacturing might be held to come within the Act, such as those in shipping departments of concerns doing business in interstate commerce, traveling salesmen, and operatives in related capacities.

1,000 BODIES a DAY

THE HUDSON WAY

BURNHAM FINNEY
Western Editor

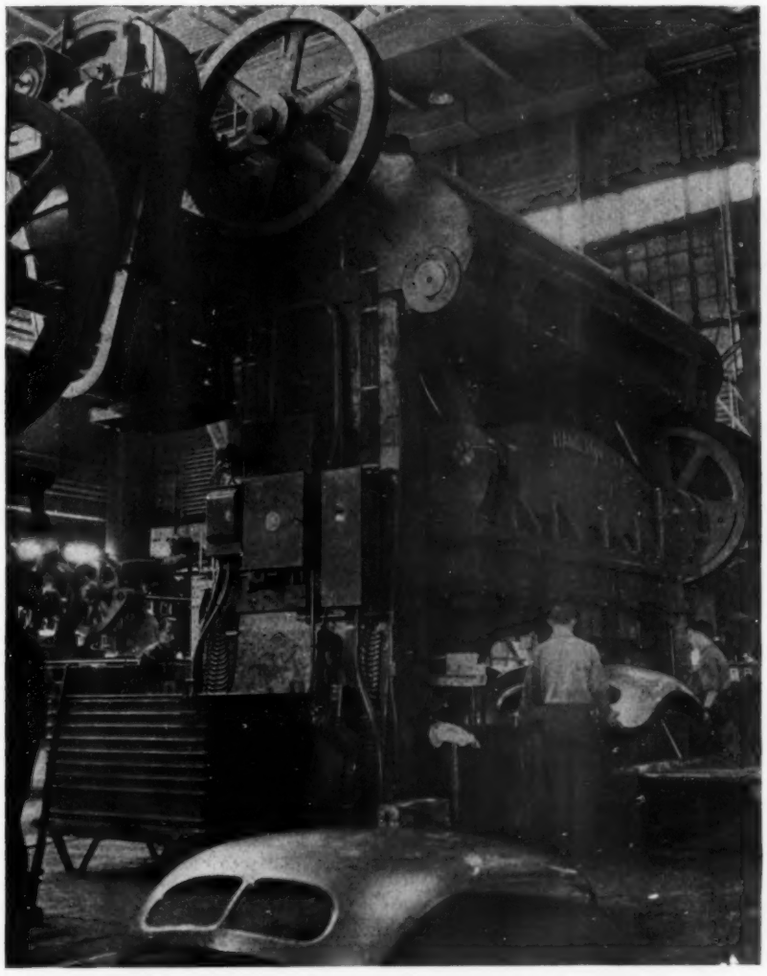
Well planned arrangement of presses and welding apparatus paves the way for well fitted bodies in the world's largest self-contained body plant

LATEST stamping practices, including the forming in one piece of the all-steel top for Hudson and Terraplane cars, are utilized in the Detroit body plant of the Hudson Motor Car Company. This plant is the largest self-contained body plant in the world. Good die work and welding technique have reduced to a negligible point the use of solder in fitting the large steel body parts together. A large amount of resistance welding is done on various body parts, hydromatic welding being ingeniously employed in several instances. Along the body production lines portable spot welders running on overhead monorails are available for various work as bodies move through the operations.

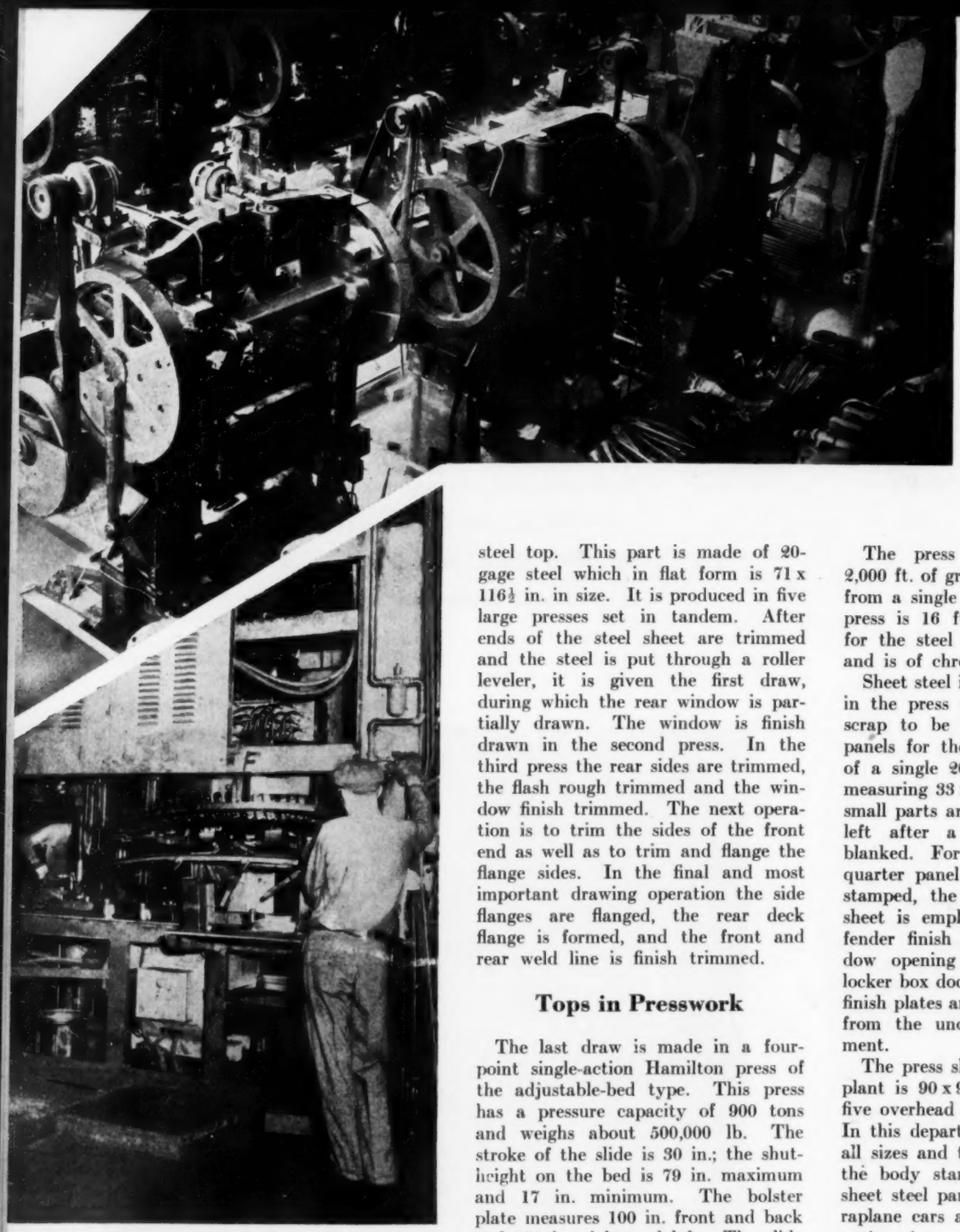
The entire plant, which occupies several floors, is served by a transportation system consisting of overhead monorail conveyors and gasoline truck-tractors. Large stamped parts, including the one-piece roof, are taken from presses to the point of assembly on monorail conveyors. Smaller parts are moved around in metal tote boxes on gasoline trucks pulled by tractors.

Stamping practice has been developed to the point where front fenders, made of 19-gage cold-rolled extra deep drawing sheet steel, are elongated 46.7 per cent in the drawing process. The depth of the draw is 19 in. Success of this operation is attributed partly to efficient maintenance and the special design of dies, and partly to the valuable help of the steel mills in furnishing sheet steel of suitable quality for severe drawing purposes.

Probably the most spectacular stamping work is the forming of the



● *A 72-ton chrome-nickel iron die performs the final drawing operation on one-piece tops in a 900-ton four-point press*



●*Five presses in series produce Hudson's new one-piece, all-steel top*

●*Wheelhousings are welded to body quarter panels in a hydromatic machine*

steel top. This part is made of 20-gage steel which in flat form is 71 x 116½ in. in size. It is produced in five large presses set in tandem. After ends of the steel sheet are trimmed and the steel is put through a roller leveler, it is given the first draw, during which the rear window is partially drawn. The window is finish drawn in the second press. In the third press the rear sides are trimmed, the flash rough trimmed and the window finish trimmed. The next operation is to trim the sides of the front end as well as to trim and flange the flange sides. In the final and most important drawing operation the side flanges are flanged, the rear deck flange is formed, and the front and rear weld line is finish trimmed.

Tops in Presswork

The last draw is made in a four-point single-action Hamilton press of the adjustable-bed type. This press has a pressure capacity of 900 tons and weighs about 500,000 lb. The stroke of the slide is 30 in.; the shut-height on the bed is 79 in. maximum and 17 in. minimum. The bolster plate measures 100 in. front and back and 180 in. right and left. The slide face is 94 x 175 in.

All adjustments of the press for die height are made by elevating or lowering the bed, this being done by motor power under push button control. There is no manual labor of locking and unlocking screw clamps. The fact that the bed is always at the most desirable height from the shop floor (down low for high dies and up for shallow dies) provides ideal conditions for handling work and increases the productive efficiency of the press. Ring risers, slide plates or other fillers are not needed on the press.

The press is lubricated through 2,000 ft. of grease line tubing operated from a single pump. The pit for the press is 16 ft. deep. The die alone for the steel top job weighs 72 tons and is of chrome-nickel iron.

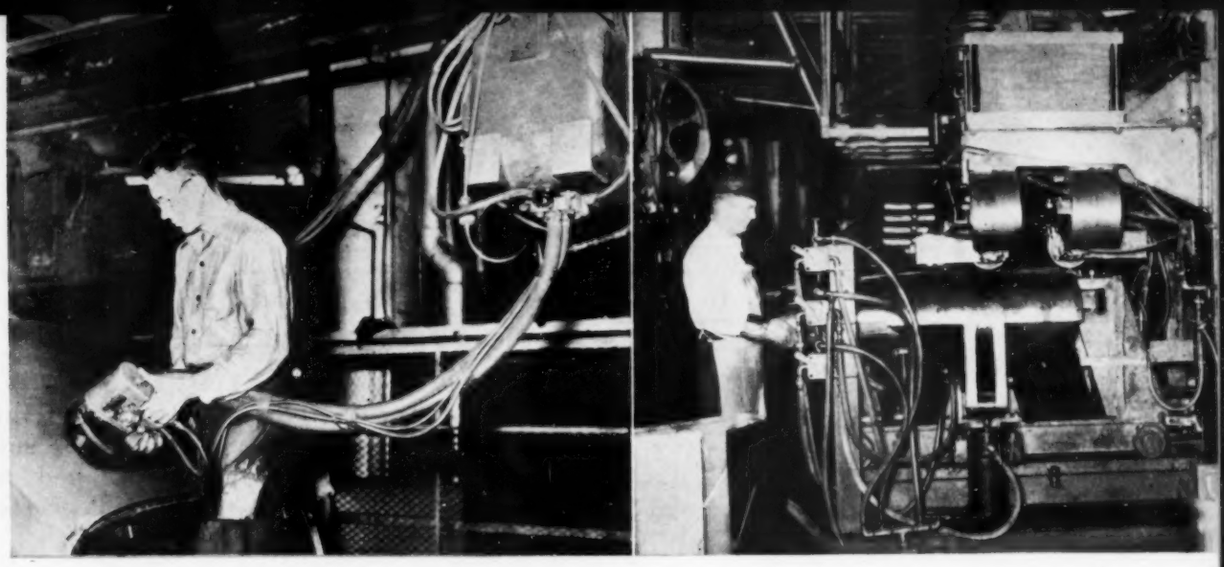
Sheet steel is used so advantageously in the press shop that there is little scrap to be disposed of. Two side panels for the body are stamped out of a single 20-gage sheet, each panel measuring 33 x 41¾ in. In some cases, small parts are made out of the scrap left after a large part has been blanked. For instance, after the body quarter panel for the coach has been stamped, the remainder of the steel sheet is employed to make the rear fender finish plate, the quarter window opening reinforcement and the locker box door. Twelve radiator shell finish plates are secured from the scrap from the underbody panel reinforcement.

The press shop at the Hudson body plant is 90 x 900 ft. and is served by five overhead electric traveling cranes. In this department are 675 presses of all sizes and types. Practically all of the body stampings and also chassis sheet steel parts for Hudson and Terraplane cars are produced in this department.

Some Punches Plated

The management has found that it pays to chromium plate some of the die punches, such as for the instrument panel, the rear fender and numerous small parts. This practice not only adds to the life of the punches, but also results in better stampings, which is far more important.

Most of the welding done on the body and other sheet steel parts is spot or gun welding. Portable gun welders are stationed along the body assembly line, each welder operating over a



• *Left—Along the body production line, portable gun welders slide on overhead trolleys*

• *Above—Gasoline tanks are fabricated in a large seam welding machine*

range of about 30 ft. on an overhead monorail. This makes it possible for workers to use them with ease as the bodies move down the line. Other types of welding also are utilized. The gasoline tank is seam welded on special machines which do the work automatically at high speed. The header is joined to the pillar of the body by means of acetylene welding.

Piece Added for Length

A novel scheme is applied to the fabrication of the steel top of the Hudson long sedan, which is 7 in. longer than other models. The steel top, the same size as for other models, is first stamped in the five presses according to the process already outlined. A section is then cut out of the center of the stamping and a longer piece inserted by means of flash welding, thus elongating the top to the proper length.

Hydromatic welding machines have been installed to attach the wheel housing to the body quarter panel and also to assemble the parts of the radiator grille for Terraplane cars. One machine produces 80 left and 80 right assemblies of wheel housings and quarter panels each hour, 29 spot welds being made in each half. In the manufacture of the grille, six parts are put into the hydromatic machine and welded together. Production is 60 grilles per hr. The machine is automatically regulated to move slowly over the heavy part being welded.

The so-called "balloon" assembly consists of the roof and the side panels welded together. The parts are placed in a special jig; on each side, between the quarter panels and the roof, an arc weld 17 in. long is made. The roof and panels fit so snugly, producing a good joint, that very little finishing of the seams is necessary.

As bodies travel along the assembly line, the arc weld seams are finished with high frequency belt sanders, one on each side of the line. These sanders are equipped with special dust collecting systems which are connected with a suction unit for drawing the dust into a covered receptacle. The dust thus is effectively and automatically removed from the atmosphere and is not a menace to the health of workers. Substantial savings in cost are made with these machines compared with the old method of filing steel joints. Around 155 bodies can be finished between belt changes.

Belt sanders cannot be used in some operations because they will not fit in with the contours of some types of bodies. Another machine has therefore been developed to do the work not reached by the belt sanders. It consists of a disk sander with a special geared head which makes it possible to apply a stream of water through the work spindle into the sanding disk and solder joint. The water mixing with the work dust forms a sludge which drops to the floor. Through use of this wet disk sander, dust particles do not get into the air, insuring the worker of healthy working conditions.

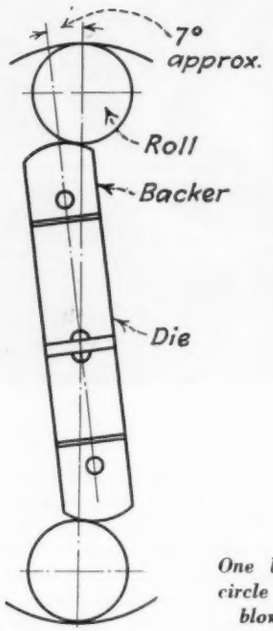
The Hudson body plant has 550,000 sq. ft. of floor space with a capacity for turning out 1,000 bodies a day.

• *High frequency belt sanders, equipped with suction dust-collecting bags finish the arc weld seams*

ROTARY SWAGING

This process of multi-blow reduction produces round sections on shaped bars with speed and precision

W. L. BOWEN, JR.
The Torrington Company



One backer for each die strikes a circle of rolls causing a rapid series of blows to be delivered to the work

SWAGING, as accomplished in a rotary swaging machine, is the process of working round, square hexagonal, or other shapes of wire, bars or tubing to reduce their diameter. It is generally done cold, although certain conditions require the work to be reduced by swaging while hot.

As used here, "swaging" refers to rotary reducing, and is not to be confused with the term "coining" or any other press operation.

While any regular cross-section, such as square, hexagonal, or octagonal can be swaged, the swaged or reduced portion is always of round cross section.

The rotary swaging machine is simply a mechanical means for bringing together two dies (sometimes four dies) with sufficient force to squeeze or hammer the work that has been placed between them.

The machine consists of a rotating spindle, carrying one or two pairs of opposed dies that meet face to face in the center. Outside of the dies, axially, and in the same slots in the rotating spindle, are backing-up steel blocks. These are called backers, and there is one for each die.

The outer faces of these backers are rounded and deliver a rapid squeezing action to the dies (and consequently to the work) by a wedging action between the backers and a multiplicity of rolls which surround the spindle and the dies.

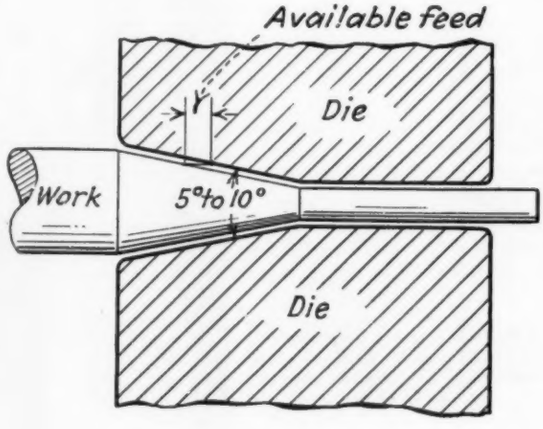
The rolls are held in a cage, called the roll rack, to keep them parallel and exacty opposite to each other. Theoretically, the number of die blows struck each minute on the work would be equal to the product of the number of rolls multiplied by the r.p.m. of the spindle. Actually, however, the wedging action of the rolls on the backers tends to rotate the roll rack in the same direction as the spindle rotation. The speed of rotation of the roll rack is about one half that of the spindle. Accordingly, the actual number of die blows per minute is about half of the theoretical amount.

Since the number of blows struck is primarily dependent upon these two factors, spindle r.p.m. and number and diameter of rolls, it would seem that increasing one or both factors would result in increased production.

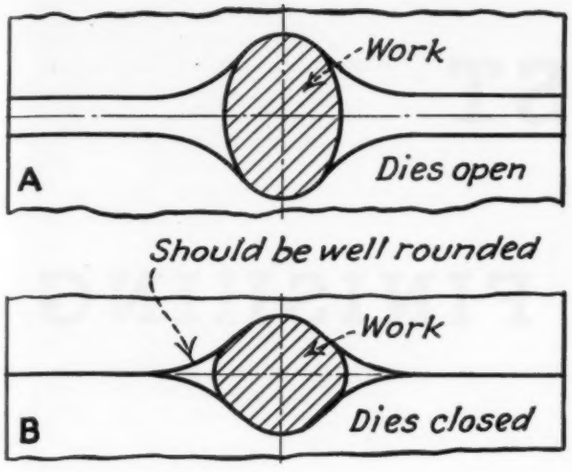
Actually this is not so, because of various conditions connected with holding and feeding the work into the dies. All types of work have some weight, which is a factor of inertia. This weight of work must be fed into the dies between the die blows. The time interval between the die blows is very small, since each blow occupies approximately 7 deg. of the spindle rotation.

As the operator pushes in the work between die blows, he has to overcome the "kick-back" from the previous blow. Since it takes a definite interval of time to feed the work, it will be seen that the faster the spindle rotates or the more rolls in the machine, the greater becomes the ratio of inertia time to available feeding time.

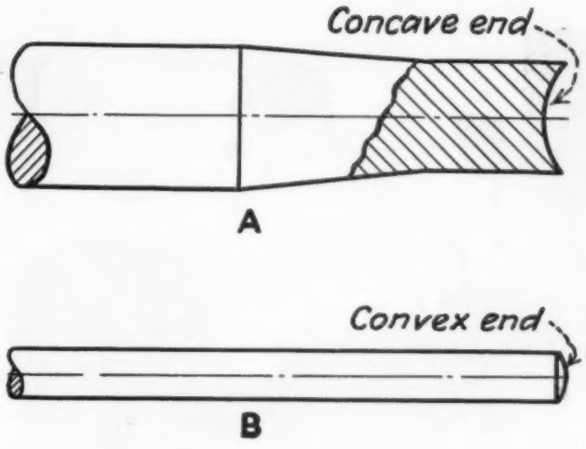
As noted in the foregoing, the dies squeeze the work through a period of about 7 deg. of spindle rotation,



Since the work can be fed only between blows, the frequency of the blows plus the inertia of the work acts as a definite limitation on the feed



On long light bars, die blows cannot be struck too closely together because the work is somewhat oval in shape until it enters the non-tapered section



Differences in metal flow between the center and outside of the bar produces a convex end on small work, a concave end on large work

the die blows striking about 56 deg. apart around the work. The dies are rotating with the spindle. Therefore, while the dies grip the work it will be seen that the work must rotate. Of course, the work tends to stop rotating as soon as the grip of the die is released, but since the interval between die blows is only a small fraction of a second, the work never has time to stop rotating. One exception to this is noted below.

While the squeeze or blow of the dies is taking place, the work is gripped hard enough to displace the metal sufficiently to form a slight oval.

Twist Affects Holders

The only sort of work that rotates very little, if at all, when being swaged, is long light work. On this sort of work, the torsional spring in the metal will return the swaged end, between die blows, to its original position. The torsional action of the light work, as well as the positive rotation of the heavier work, must be considered when designing mechanical feeds and holders.

The die blows cannot be struck too closely together, measuring angularly around the work, because the work is more or less oval-shaped until it passes into the blade (non-tapered section) of the dies. It will be seen that striking blows too closely together can only result in twisting the work and preventing good swaging.

When the dies strike the work, the metal flows in all directions, according to Poisson's ratio. Thus some of the flow of the metal is toward the operator, and is called "kick-back". Of course, there is also a flow toward the back of the machine, which is influenced to some extent by the taper in the dies. When swaging heavy work, the end of the swaged portion comes out cup-shaped or concave. This indicates that the surface of the work flows faster than the inside.

On small work, the center of the end is likely to bulge out, giving a convex end. In this case the surface flow is less than the inside flow. This makes it possible to take material with a radial grain, such as cast bars of tungsten, and to lay the fibers lengthwise of the bar or rod by swaging. The swaging increases its ultimate tensile stress several times and also its ductility.

The best medium for holding work being swaged is the hands, as they allow for "kick-back", frictionally control the rotation of the work and apply feeding pressure at the same time. Rotational control is accomplished without adding any pressure in this direction, which is important.

Mechanical holders, unless the work is allowed to rotate in the holder, are likely to cause the work to twist off because of the inability of their weight to follow through with the blow. There is an acceleration from zero to full spindle speed in an extremely short interval of time, which of course applies a great torsional force to the work.

The twisting and "kick-back" forces, if opposed too rigidly by a mechanical feed, are sufficient either to break the work or the feeding attachment.

Because of design, sometimes the work must be swaged at such a steep angle that it is impossible to force the work into the dies by hand. In such cases a rack and pinion feed is used, the work being allowed to rotate.

The amount of reduction accomplished by swaging depends on the material, but in general, the maximum reduction for each swaging operation or "pass" is about forty per cent of the area.

The pressure required to make swaged reductions depends upon the material and the size of the work. The larger Torrington swaging machines are designed to withstand pressures as high as 200,000 lbs. per sq. in.

The outside diameter of swaged tubes, or the diameter of swaged solid work, can be held to a tolerance of 0.001 in. for each ¼ in. of diameter of the work, assuming the machine is large enough for the job.

Group Drive

Individual motor drive is becoming so common that it may seem like a step backward to even mention shafting and countershafts. But there are still a number of practical shop men who believe that there is a place for group drives. Motor cost as well as efficiency make them sure of their position. One quotes $68 per hp. for ½-hp. motors and $7.82 per hp. for 40-hp. motors in support of this. But he insists on steel stringer construction for all shafts to insure alignment and hangers with anti-friction bearings.

FAST FINISHING

A hand operation gives the final polish to edges, sides and backs, rounds the sharp corner at the bottom edge

High-speed processing fills the need for attractive finish, economically applied, on merchandise items

H. L. FARBER

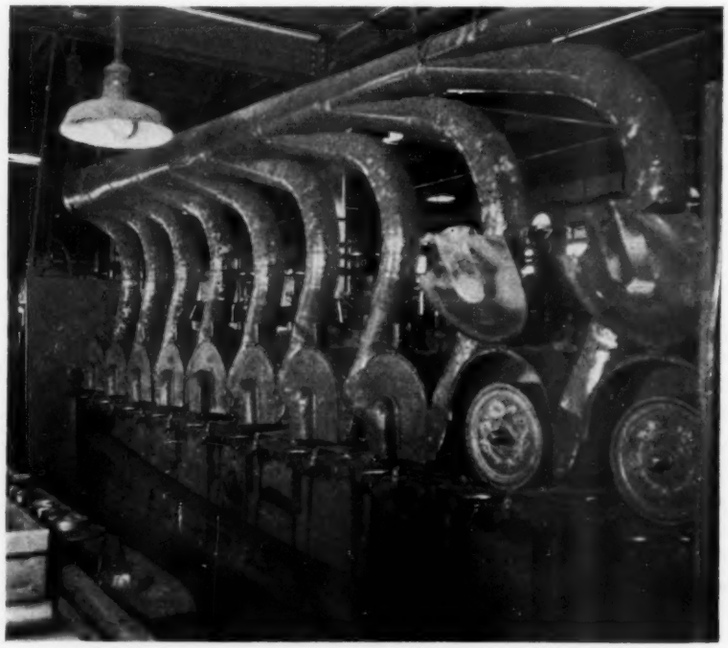
Chemical Laboratory
Westinghouse Electric & Mfg. Co.

Style and beauty have so marked merchandise that these two attributes are important factors in even such a prosaic subject as an electric sad iron, if the manufacturer anticipates a return on his investment. Since style and beauty are visible features, giving what is commonly known in the trade as "eye appeal", it follows that in the case of an electric iron, the exterior must be most carefully and considerately treated. It is this careful treatment that places unusual and stringent demands on the metal-finishing, polishing and cleaning operations of a factory.

Fortunately, along with the demand for style and beauty, industry has kept pace and contributed developments in automatic machines and hand tools, allowing the manufacturer to produce a superior product, and at the same time, to keep his costs down to where the finished item finds public acceptance. Automatic machinery, of course, plays a most important part in the process of making an iron but there are some operations that cannot be done on a machine.

The parts to be finished on the iron base are a cold-rolled steel cover, a cast iron base, front and rear handle straps, heel rests, handle bolts and rivets.

In following these parts through the cleaning, finishing and polishing operations, the top of the iron base is first



Fine finish is given the bases by three passes through a ten-wheel automatic polishing machine

ground down 0.015 in. to provide a flat surface for the element and cover. This is done on a specially built circular grinding machine, one operator performing the loading and unloading operations. Maximum production of this machine is approximately 30 pieces per min., the iron bases passing under four wheels, 9 to 14 in. in diameter, with 5½-in. faces and 1¾-in. arbors; one 10 grit, two 20 grit, and the last wheel 60 grit.

Following this top grinding operation comes the drilling and tapping for the thermostat well. To reach the drilling and tapping machine, the bases pass along a conveyor. The drilling and tapping operation is accomplished on a machine that is equipped with a cam-operated fixture, manually loaded and automatically unloaded, capable of delivering 10 parts per min., drilling and tapping eight holes at a time.

The iron bases are taken from the drilling and tapping machine delivered to a battery of disk grinding machines for grinding the edges of the base. The edge grinding process requires two operations on disks, consisting of a 30-in. abrasive wheel ½-in. thick, 12 grit. The work locating fixture, set at an angle of 58 deg., is cam-actuated, capable of grinding three different radii.

The base then goes through a similar operation on another machine, which is set to grind the other edge. In other words, this particular machine grinds only one edge. Clamping is automatic at these machines, the operator removing the piece and setting a new one in place at the loading and unloading station. After this operation, the sides are hand polished on wheels set up with 150 grit. This is followed by a polishing operation using 180-grit emery abrasive.

Three different radii on the iron base are edge ground with the work held in a cam-actuated angular fixture

The heel, or back of base, is ground on a similar machine, using first 12 grit for roughing, then 120 grit for grinding. This machine has an 18-in. disk grinding wheel and a special holding fixture.

The bases then go to a 10-wheel, tandem type, automatic polishing machine where they are given three passes. On the first pass, for rough grinding, the bases receive treatment from two 10-grit, three 24-grit, three 36-grit and two 60-grit wheels. On the second pass they are treated with fine grinding wheels, three 60-grit and seven 80-grit. On the third and final pass, for polishing and oiling, the routine is, two 80-grit and four 120-grit (dry), then one 120-grit and three 160-grit, using grease stick.

The bases are then inspected for flaws in finish or dimensions.

Following the inspection operation, the bases go through a hand polishing operation for the edge, side and back, using a 120-grit wheel set-up with glue and emery. Then they are oiled out, using 160-grit, covering the same side and edge and back. During this operation, the sharp bottom edge is rounded. In the glue room wheels are prepared for all polishing and grinding operations.

Wheels are prepared in the glue room for all polishing and grinding operations

The bases are again inspected, following the rounding of the edges, and then are ready for the plating process.

The sheet metal cover of the iron is polished by hand, since its surface presents curves that are difficult to polish on an automatic machine. This polishing operation is done on compressed canvas wheels set up with 140-grit wheels of manufactured alumina. The iron covers are then inspected for scratches, die marks, or any other imperfections that might result from handling or processing.

The covers go from the inspection through a brushing operation on grade C-10 Tampica brush wheels, 16-in. in diameter, and 4-in. face. Following another inspection, these cover plates are ready for plating.

The other small parts of the iron, the handle strap and heel rest, are barrel burnished, using steel shot, soap and hot water.

All parts of the iron to be plated, polished bases, covers, handle straps and heel rests, are racked and cleaned in an emulsified soap solution, consisting of 1.5 oz. tri sodium phosphate; 1.5 oz. caustic soda; 0.9 oz. soda ash; 0.84 oz. sodium metasilicate; 0.9 oz. fatty acid as soap; 0.06 oz. bentonite clay; and 0.3 oz. rosin. The solution, having a total of 6 oz. per gallon of cleaning material, is operated at boiling temperature and parts are cleaned by immersion for three minutes.

A water rinse follows, and then the parts are electro-cleaned in an alkaline copper cleaner, using a different formula for the solution and adding 6 volts, direct current for approximately one minute.

Another water rinse follows, and the parts are placed in the moving-cathode nickel plating tanks where they are allowed to remain until a deposit of 0.0001-in. of nickel is obtained. The current density for nickel plating averages 12 amps. per sq. ft. at 3½ volts. The solution formula for the nickel operation is:

Nickel ammonium sulphate	10 oz.
Nickel sulphate	10 oz.
Sodium chloride	4 oz.
Boracic acid	4 oz.
Magnesium sulphate	4 oz.
Water	1 gal.

After cleaning, parts are nickel plated in moving cathode tanks

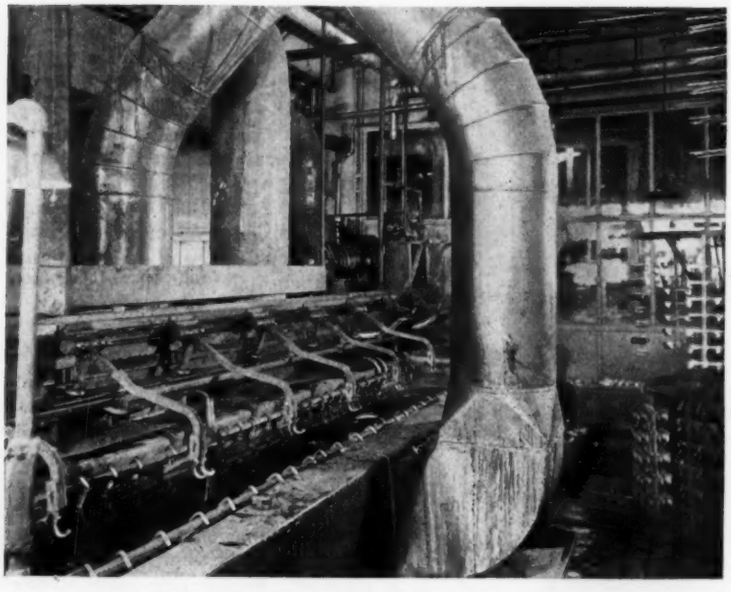
All factors entering in the plating process, such as current density, plating time and temperatures, are standardized and placed on process charts near the operation.

The racked parts are rinsed in cold and hot water, following the plating operation, and then are placed on an unloading conveyor. The buffing department receives the finished plated parts, and the covers are buffed by hand on buffing lathes running at 3,400 r.p.m. using seven sections of 16-in. diameter, 30 ply, ¼-in. sewed muslin buffs.

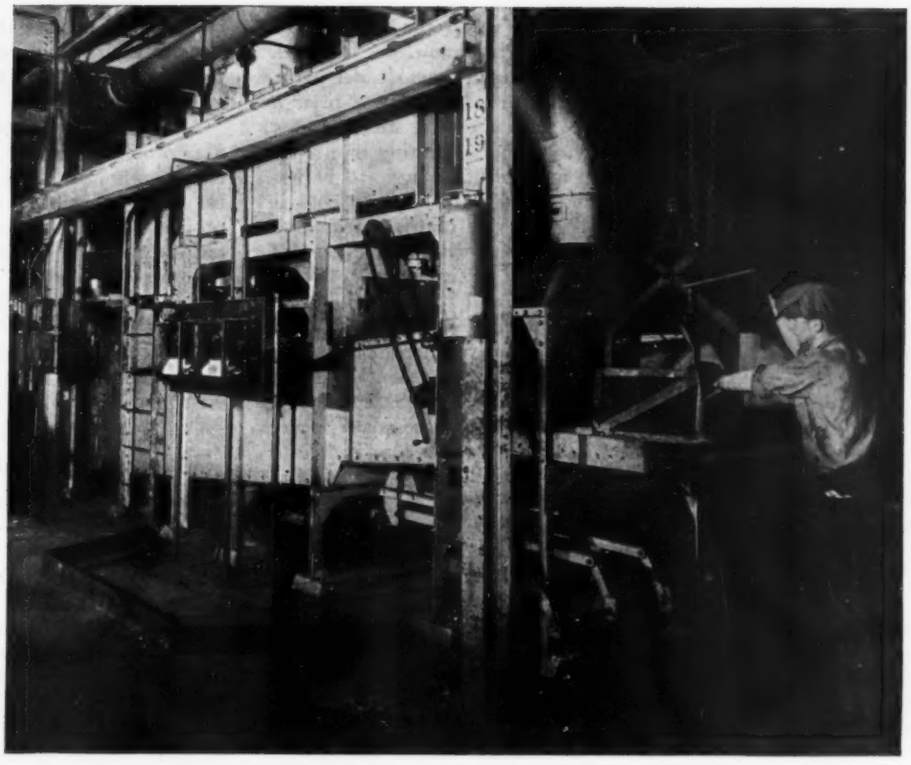
When the buffs reach a diameter of 10 in. as the periphery changes, they are discarded and can be used on other pieces of apparatus. The iron base edges are buffed by hand, while the bottom is buffed on an automatic oscillating buffing machine.

All parts that are sent to the chromium plating department are put on special racks and are plated on an automatic chromium plating machine. The parts are put through an alkaline electro-cleaner, a water shower, a rinse, and a second water shower before entering the solution. Two water rinses and a final cold water spray follow a 3-min. plating period. From this point the parts pass through a hot air drying tunnel. A final cold water shower overcomes all water stains on the plated parts.

Followng a rigid inspection, the parts are taken to the assembly line by a conveyor.



Carried on special racks, the work is chromium plated in an automatic machine



It's a far cry from hardening tools and parts with hand forges of yesterday to today's scientifically built and accurately controlled furnaces—an important milestone in metallurgical progress

Yesterday's Heat-Treating

Imminence of the Metals Show arouses memories of the days when heat-treating was hardening and alloys were rare, in this eleventh article of a series of reminiscences

FRED H. COLVIN
Editor

THE coming National Metals Show in Cleveland stirs many memories of my early days in the shop and shows almost unbelievable changes. It is a far cry from the small portable hand operated forge in which we heated our tools for hardening, and present day furnaces with controlled atmosphere that eliminates scaling and cracks due to uneven heating.

Using soft coal for fuel we carefully built up a fire that looked something like a young beehive and sprinkled water all over the top to retard its catching fire and to "coke" the fuel inside. Then we dug a small opening in front to insert the tool, covering the opening as best we could to prevent escape of heat. Heating temperatures were a matter of eye judgment. "Cherry red," "white heat," and other terms described the heats with about the same accuracy as a "scant thirty-second" or a "full seven-eighths." Just how many degrees these eye measurements varied with the brightness of the day will never be known. It was this variation that led to having hardening rooms dark at all times in many shops. The first "daylight" hardening room I saw was something of a revelation.

Hardening and tempering were largely a matter of chance although the comparatively small percentage of failure is rather remarkable. It is probable that the low cutting speeds, the lack of power in the machine tools of that day and lack of knowledge as to what production was possible, made the cutting tool problem less difficult than we realized. It must not be thought, however, that the machinist of those days had no production troubles. Piecework was common practice and the art of cutting the piece-

rate when a fast man earned more than he was supposed to do, was well under way. The probable fact is that with the steels, the hardening methods and the machines then in use, differences in output caused by variations in any of them were not as noticeable as would be the case today.

While some muffle furnaces were in use, especially for drawing the temper to the working point, most tools were drawn in the forge. This was frequently done by placing a piece of sheet iron or thin plate over the fire after it had been leveled down. The tool to be drawn was laid on this plate, moved frequently to get an even distribution of heat, and watched carefully to catch the first pale tinge of yellow, or straw, which indicated that the color was beginning to run.

Eye Is Crude Tester

All who have had any experience with heating steels know how the color changes as the heat increases. Every book on tool hardening gives a list of colors, or even a color chart by which to judge hardness. But this method is crude at best as compared with the use of pyrometers that control temperatures far more accurately than the human eye can possibly do.

This running of colors recalls an incident in the old shop. As with most shops we had a boaster, who knew it all. You couldn't fool him on steels, he knew them all by their first name. One of our milling jobs on brass was done with a single point fly cutter. These cutters were made of quarter inch flat tool steel about two inches wide. They were cut off from the bar in an almost triangular shape which required very little work to file them to shape before hardening.

We made these up in lots of six or more and it was the "expert's" job on this occasion to make a batch of cutters. He had been particularly obnoxious recently and so we put up a job on him. One of us filed up a blank of wrought iron of the same shape as his cutters and substituted it for one of his. He heated and dipped the cutters and then drew the temper over the hot plate as usual. As a few of us had discovered, a piece of iron will show "colors" almost identical with steel. The iron cutter colored up the same as the rest and quite by chance he picked that for his first milling job.

Of course the edge promptly turned over and he began to cuss the steel until we suggested that he try another cutter. None of us were backward in telling him what had happened, and it was some time before he boasted of his knowledge of steel.

The hardening of long, slender parts, such as reamers, has always been a problem. In our case it was almost a calamity. Uniform heating of a long piece in a forge fire is next to impossible, and to dip it so as to cool it uniformly was one of the things that couldn't be done with any degree of certainty. So straightening was always in order and it was a job that gave relief when it was over.

This recalls an old toolmaker who had quite a reputation for hardening these difficult pieces. Whether he had any special methods or not I never found out. But he was always free to tell just how he did it. "No trick at all," he used to say. "All you have to do is to heat the reamer *perfectly even* all over, and then dip it *perfectly straight*. That's all there is to it." Just how to heat them evenly or keep them perfectly straight, he always forgot to tell us.

It would be a treat to see one of these old time toolmakers walk through a modern heat-treating department such as Pratt & Whitney or many another.

The Drama of Alloys

Materials continue to form one of the most interesting phases of our development to the old timer who keeps his eyes open and his ear to the ground. Not only do new steels pop up with disconcerting regularity but alloys of aluminum and the bronzes show amazing qualities. The hardening or tempering of copper has long been touted as a lost art in the evident endeavor to show what decadence has taken place since the "good old days." Every so often we have had rediscovery of the art, usually exemplified by "razors that will shave." For most practical purposes the answer might well be "so what?" in the parlance of the day. Because for most purposes steel is better as well as cheaper.

New alloys, however, such as beryllium copper, have it all over anything the ancients may have had. While razors might be made of it, why waste time in fields that are not practicable? One of its particular uses is for chisels and wrenches in industries where a spark might blow the whole plant to kingdom come. For these new alloys will cut steel and are free from all danger of sparking. There is no intention to discredit the work done by those gone before. But I have little patience with those who are constantly looking backwards for inspiration and who think that the men and boys of their day were superior to the present crop. May I never reach that stage!

All of these new materials impose new problems for the production man to struggle with and to solve. And he solves them—or else! The two problems of holding the material and of picking the right cutting tools confront him at every step. Cutting edges, clearance angles, cutting speeds, feeds and depth of cut all have to be studied as well as the coolant or lubricant to be used. And these may vary enough with different alloys to require special tools for some of the alloys.

Testing Machines' Heyday

Hardness of both tools and materials to be cut has also become a task for the production man. Scleroscope, Brinell and Rockwell methods are now common. Fifty years ago the file was the only test, especially for cutting tools. For, while we depended largely on "temper color" in drawn tools, the fine or even the dead smooth file was the court of last resort. But though we now use the best hardness measuring methods we know of, there are few shops where the file has been entirely abandoned. We have learned, however, that extreme hardness is not the only requirement of all cutting tools, especially with some of the high speed steels. Nor is hardness the prime requisite for gages.

One of the greatest changes has perhaps taken place in the heat-treatment of low carbon steels. We used to call this case-hardening, which in its simplest form consisted of heating the iron or low carbon steel, covering it with cyanide crystals by rubbing or sprinkling them on the work, continuing the heat until it melted all over the surface and then dipping in water. We also used what we now call pack-hardening, surrounding the parts with granulated bone, leather, charcoal and other ingredients. Some of the concoctions formerly used to get carbon into the surface would have done credit to the Witch of Endor.

Case-hardening became carbonizing and now carburizing. The results with some of the modern alloy steels are astonishing. To one who recalls the early automobile transmission gears, or the "dental" work every toolmaker had to perform on ring gears in scroll chucks, the practically unbreakable gear teeth of today are a source of constant wonder. And the methods of securing these hard surface, tough center and long wearing gears are another mark of our progress.

Talking Shop

Three for One

One of our Illinois friends writes that he believes there are three jobs for every qualified machinist in that part of the country. And the same story

comes from St. Louis and Cleveland and from other industrial centers.

This is good news for the machinists, who got little enough encouragement in the tough days of depression when most of the help seemed to be provided for the farmers and those in the unskilled labor ranks. Every project that was proposed on which machinists would have been needed was blocked in one way or another by officials blind to the importance of machinery and the machinist in our modern way of living. When all the machines and machinists are busy everywhere we shall be prosperous once more.

Broaching Gains

A pair of picture pages in this number of *American Machinist* gives further evidence of the amazing progress made by broaching in the automobile shops. Packard has gone all the way in equipping the block line for its new light six, as the photographs show. Some of the broaching units are the first of their type.

Not all of the automobile companies have gone over to broaching to such an extent as is indicated at Packard, but fashions in metal-working, if they are good, have a way of spreading, particularly among the automobile manufacturers. Their plants are pretty well concentrated and their production men are thus in a fortunate position to exchange ideas on the merits of machines and methods.

It wasn't so many months ago that surface broaching was a novel idea. Now it is accepted. The companies making broaching equipment are rushed, those making superseded equipment are looking for other markets. Which is typical of American industry and emphasizes the need for constant experimentation and invention if a company is to keep its competitive position.

Sheer Carelessness

Why it is that we work and study and sweat to save five dollars in the manufacturing cost of a product and

then think nothing of wasting fifty or a hundred in sales plans that have not been as carefully planned?

Possibly it is the same sort of carelessness that was described the other day by a consulting engineer who specializes in small tool applications and toolroom methods. He told about visiting one plant where the tool supervisor took pride in his toolcrib and the well arranged bins for edge tools.

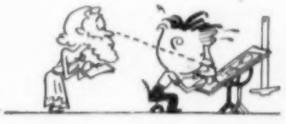
In the tap section every bin was carefully lined with heavy felt to protect the cutting edges of the tools. But in more than half of the bins the taps were piled in two and three deep with nothing to prevent them from nicking or gouging each other.

It seems hard to believe that such a thing could happen, yet it is entirely typical of much that does happen in almost every shop. A man may be careful nine-tenths of the time and then do a thing like throwing a handful of sharp taps into a bin without a thought of the consequences.

Is There Anything New?

Speaking of taps and small tools reminds us that once, long years ago, Oberlin Smith of Ferracute remarked that it was "amazing how often the ancients had stolen our inventions." This was brought to mind by a recent visit to one of the ancient and honorable tool shops whose existence extends back before the Civil War. Stored away in a rack in one of the toolcribs is a motley collection of drills, reamers and similar tools, some of which date back fifty years or more.

"You may think it funny we don't scrap those and get them out of the way," said the super. "But they are a real asset. Every once in a while some of our bright young men get a brain storm and design a new drill or reamer. They look fine on paper



and we think we're on the track of a real development. But before we go ahead to revolutionize the world with our discoveries we come up and look over this pile of junk. You'd be surprised how often we find the twin brother of the new idea tucked away here where it had been forgotten for a long, long time, and then some old timer remembers why it didn't work out."

The Editors.

STANDARDIZED HOBBING

Carefully developed instructions for hobbing and inspection are a profitable substitute for the confusion of everyone working to his own ideas

L. P. SITTIG

A CORPORATION, whose product includes some 120 different kinds of small gears, found that considerable difficulty was experienced in obtaining a uniform product. Volume of work was sufficient to keep a dozen machines busy. Gears of the same kind of material and the same pitch were not alike in running qualities, as judged by the final inspection department. Gears of the same pitch and same diameter showed great variation in the smoothness of teeth; some gears were smooth on one side of the tooth and rough on the other side. A wide variation was also shown in piecework rates.

These factors were investigated by the planning department and traced to the following causes:

(a) Whenever setting up a new job the operator had no instructions in advance, but arbitrarily determined upon a certain feed and then requested the tool designing department to figure the index gears and feed gears in accordance with that feed. The cutting speed was left to the operator's judgment. If the feed seemed too coarse, it was arbitrarily decreased and another combination of gears figured.

(b) Because the index gears and feed gears were figured independently for each job, and no comparisons were made with a standard, it was impossible to produce uniformly smooth teeth.

(c) The inspection department had no standard by which to judge the smoothness of tooth flanks and the running qualities of the gears, but used an arbitrary judgment in each case. If the chief inspector decided that the cut was too rough, a finer feed had to be chosen and another set of change gears figured for the hobbing machine. Since the gears had to be very accurately cut, it generally took from one-half to three-quarters of an hour to figure a set of gears with an error allowance sufficiently small.

To overcome these objections and achieve a degree of standardization that would insure a uniform product, a program such as follows was outlined:

1. The determination of standard feeds based upon the average of past practice.
2. The figuring of change gears based upon the standard feeds.
3. The establishment of operation instructions to show the hobbing machine set-up and the change gears to be used.

Table I—Feeds for Hobbing Screw Steel

Pitch	19	20	22	24	26	28	30	32	34	40	48
Spur gears	.042	.040	.039	.038	.037	.036	.035	.034	.033	.030	.026
Spiral gears 5 - 10°	.0418	.0398	.0388	.0378	.0368	.0358	.0348	.0338	.0328	.0298	.0259
10 - 15°	.0413	.0394	.0384	.0374	.0364	.0354	.0344	.0334	.0324	.0294	.0256
15 - 20°	.0405	.0386	.0376	.0367	.0357	.0347	.0338	.0328	.0318	.0289	.0251
20 - 25°	.0394	.0376	.0366	.0356	.0347	.0338	.0328	.0319	.031	.0281	.0244
25 - 30°	.038	.0362	.0353	.0344	.0335	.0327	.0317	.0308	.0299	.0271	.0235
30 - 35°	.0363	.0346	.0337	.0329	.032	.0311	.0303	.0294	.0285	.0259	.0225
35 - 40°	.0344	.0328	.0319	.0311	.0303	.0294	.0286	.0278	.027	.0245	.0212
40 - 45°	.0321	.0306	.0298	.0291	.0283	.0275	.0268	.026	.0252	.0229	.0199
45 - 50°	.0296	.0283	.0275	.0268	.0261	.0254	.0247	.024	.0233	.0212	.0183
50 - 55°	.0269	.0257	.025	.0244	.0237	.0231	.0224	.0218	.0212	.0192	.0167
55 - 60°	.024	.0229	.0223	.0217	.0212	.0206	.020	.0195	.0189	.0172	.0149
60 - 65°	.021	.020	.0195	.019	.0185	.018	.0175	.017	.0165	.015	.013
65 - 70°	.0177	.0169	.0164	.016	.0156	.0152	.0147	.0143	.0139	.0126	.0109
70 - 75°	.0143	.0137	.0133	.0129	.0126	.0123	.0119	.0116	.0112	.0102	.0089
75 - 80°	.0108	.0103	.010	.0098	.0095	.0093	.0089	.0087	.0085	.0077	.0067
80 - 85°	.0072	.0069	.0067	.0065	.0064	.0062	.006	.0059	.0057	.0052	.0045
85 - 90°	.0036	.0035	.0033	.0033	.0032	.0031	.003	.0029	.0028	.0026	.0022

Feeds for bronze = 1.5 x above

4. The issuing of inspection instructions specifying the permissible width of tooth marks on the tooth flanks of gears.

In line with this program of standardization, Tables I and II were compiled to show the feeds to be used for gears of steel or of bakelite. Very few bronze gears were used and a satisfactory standard for these was established by specifying a feed 1½ times that for steel. The tables show the feed per revolution of work for hobbing steel gears and gears of linen-base bakelite. The feeds for various angles of helix were computed by the formula: "feed per rev. of cutter x sin. helix angle = feed per rev. of work."

The use of these tables insured that all gears of the same pitch would have the same spacing of revolution marks on the teeth regardless of their helix angle. Of course, the depth-of-revolution marks were kept to a minimum by checking the eccentricity of the hob on its arbor, and limiting this to 0.0005 in. The hob teeth were machine ground to retain accurate spacing of the cutting edges.

Since all of the hobbing machines in this plant were No. 8 Barber-Colman machines, the change gears had to be figured according to formulas applicable to this type of machine.

For cutting spur gears and ratchets, these formulas are as follows:

N = number of teeth to be cut

for index gears, $\frac{12}{N} = \frac{\text{drivers}}{\text{driven}}$

for feed gears, $\frac{\text{feed}}{0.075} = \frac{\text{drivers}}{\text{driven}}$

For speed gears, Table III was used, this being applicable to helical and worm gears also.

For cutting worm gears, these formulas were required:

B = number of threads in worm or hob.

C = number of teeth in worm gear.

D = feed per rev. of hob, assumed as follows:

19 pitch —0.011 feed per rev. of hob
20 pitch —0.010 feed per rev. of hob
22 pitch —0.009 feed per rev. of hob
26 pitch —0.008 feed per rev. of hob
28 pitch —0.007 feed per rev. of hob

for index gears, $\frac{12 \times B}{\quad} = \frac{\text{drivers}}{\text{driven}}$

for vertical feed gears,

$$\frac{D \times C}{0.1875 \times B} = \frac{\text{drivers}}{\text{driven}}$$

Table III—Speeds for Hobbing—No. 3 Barber-Colman Machine

dia. hob	screw steel	bakelite & bronze
1/2	18/36	
3/4	18/36	
1	20/34	
1-1/4	22/32	18/36
1-7/8	25/29	20/34
2-1/2	29/25	22/32

gears shown are as in position on machine, driven above - driver below.

Table II—Feeds for Hobbing Bakelite

Pitch	19	20	21	22	24	26	28	30
Spur gears	.084	.080	.079	.078	.076	.074	.072	.070
Spiral gears 5 - 10°	.0836	.0796	.0786	.0777	.0757	.0737	.0717	.0697
10 - 15°	.0826	.0788	.0777	.0768	.0748	.0728	.0708	.0689
15 - 20°	.081	.0772	.0763	.0752	.0734	.0714	.0694	.0676
20 - 25°	.0788	.0752	.0742	.0732	.0712	.0694	.0676	.0657
25 - 30°	.076	.0724	.0715	.0706	.0688	.067	.0654	.0634
30 - 35°	.0726	.0692	.0684	.0674	.0658	.064	.0622	.0606
35 - 40°	.0688	.0656	.0647	.0638	.0622	.0606	.0588	.0573
40 - 45°	.0642	.0612	.0605	.0596	.0582	.0566	.055	.0536
45 - 50°	.0592	.0566	.0558	.055	.0536	.0522	.0508	.0494
50 - 55°	.0538	.0514	.0507	.050	.0488	.0474	.0462	.0449
55 - 60°	.048	.0458	.0453	.0446	.0434	.0424	.0412	.0401
60 - 65°	.042	.040	.0396	.039	.038	.037	.036	.035
65 - 70°	.0354	.0338	.0333	.0328	.032	.0312	.0304	.0295
70 - 75°	.0286	.0274	.027	.0266	.0258	.0252	.0246	.0239
75 - 80°	.0216	.0206	.0204	.020	.0196	.019	.0186	.0181
80 - 85°	.0144	.0138	.0137	.0134	.013	.0128	.0124	.0121
85 - 90°	.0072	.070	.0068	.0067	.0066	.0064	.0062	.0061

Finding gears to correspond with the decimal ratios is best accomplished by the method of continued fractions. To avoid figuring gears that would be too large, the ratios obtained were checked with the following requirements admissable by the gear centers on the machine:

largest driver = 80
largest driven = 76
largest sum of driver and driven = 116

The above data, and that which follows, was assembled in blueprint form and bound in a properly labeled folder so that it would be readily available for whoever was assigned to the duty of writing operation instructions. As will be noticed, the information in this data book is clear enough so that even an inexperienced engineer can figure a set of change gears for a new job.

Index Gears for Helical Gears

Helical gears require a more extensive calculation than other types, and the following formulas are required: For index gears,

$$\frac{\text{Feed} \times \text{sin. helix angle}}{\text{circular pitch}} = \text{fraction } A$$

Fraction A may be most conveniently chosen from the table of fractional equivalents in the *American Machinists' Handbook*. Then we have the formula:

$$\frac{12}{\text{No. of teeth} - A} = \frac{\text{drivers}}{\text{driven}}$$

The gears may be factored from a table which shows the gears available on the machine. If the ratio will not factor, the fraction A must be changed slightly.

It is always advisable to have the direction of helix of the hob the same as that of the gear to be cut. Such a condition produces the smoothest finish and avoids any tendency to harm the cutting edges of the hob. If the direction of angle is not the same, and the angle is more than 45 deg., the hob has a tendency to push the work ahead of it, in a manner similar to that of a milling job where the work is fed in the same direction as the cutter teeth. When the stock of hobs on hand calls for the emergency use of a hob whose direction of angle is opposite to that of the work, it is necessary to figure the index gears with the formula:

$$\frac{12}{\text{No. of teeth} + A} = \frac{\text{drivers}}{\text{driven}}$$

Feed Gears for Helical Gears

Since the index train and the feed gear train must work in unison to generate a helical path, it is necessary to use great care in figuring the feed gears. The gears available on the machine will seldom furnish a ratio exactly equal to the theoretical feed. For the product required in the plant here mentioned, an error allowance was worked out for various helix angles, as shown in Table IV. This allowance represents an error of 6 sec. of angle or 0.1 min., which is close enough for the most rigid accuracy requirements in the pitches under consideration. To conform to this standard of accuracy, it is necessary to figure the theoretical feed to six places of decimals, using the formulas:

A x cir. pitch x cosec. angle = theoretical feed.

$$\text{feed gears} = \frac{\text{theoretical feed}}{0.075} = \frac{\text{drivers}}{\text{driven}}$$

Set-Up Instructions for Hobbing

Having figured the change gears for a hobbing operation according to standardized conditions, a record of these gears and the set-up instructions for the job should be placed on a standard-operation instruction print. The set-up diagram would look something like Fig. 1.

If the direction of helix on hob and gear are the same, the angle of swivel on the hobbing machine will be equal to the helix angle minus the thread angle stamped on the hob. When the direction of helix on hob and gear are different, the angle of swivel is equal to the helix angle plus the thread angle.

The standard swivel on the No. 3 Barber-Colman hobbing machine allows of using a 1⅞-in. diameter hob, which should be specified for all helix angles less than 45 deg. For helical gears of steeper angle, a 2½-in. hob should be used on a special swivel provided with a short arbor and a flywheel on the driving end. To facilitate setting up, the instructions may include a note based on the data below, and for left-hand hobs, an idler gear must be specified in both the index gear train and the feed gear train, this to be placed between the first driver and the intermediate gear.

Table IV—Allowable Error in Helical Gear Angles

angle	error allowed
10°	.0009
20	.0002
30	.0001
40	.00005
50	.00003
60	.00002
70	.00001
80	.000005

By using operation-instruction prints embodying the data shown, and also specifying a motion study for loading and removing the work, a consistent and equitable piece rate was established for each part.

The difficulties met with in inspection were removed by an inspection-instruction including such a specification as this:

"Check outside dia. and depth of tooth, 5 per cent.

Check thickness of tooth at pitch line and helix angle, 20 per cent.

See that revolution marks on flanks of teeth from hobbing are not longer than 0.034 in." 5 per cent.

The length of revolution mark permissible was specified the same as the feed per revolution for a spur gear of equal pitch.

This experience of eliminating manufacturing difficulties by standardization is indicative of what may be accomplished in many other operations. Briefly, it demands careful analysis and the application of mathematical principles wherever possible.

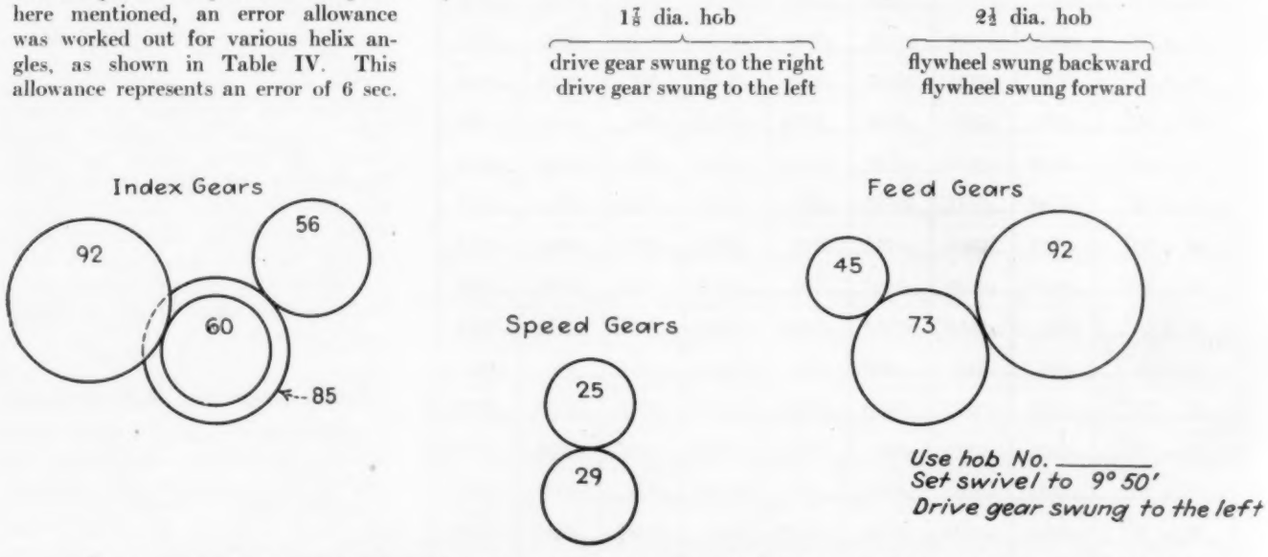


Fig. 1—A standard operation-instruction sheet should be prepared to give a record of the change gears and set-up

XIII—Trimming dies are built for formed or drawn parts, as well as swaged work, drop forgings and die-castings

DIE DESIGN and DIE MAKING

E. G. MARSHALL
Master Mechanic, Charleston Works, The American Fork & Hoe Company

THERE are times when engineering changes require trimming a blank. In this case it is cheaper to run the part in the original blank die and then trim the part, than to make a new blank die. Again, the blank may be used in one size as it comes from the die, and be trimmed for use in another size.

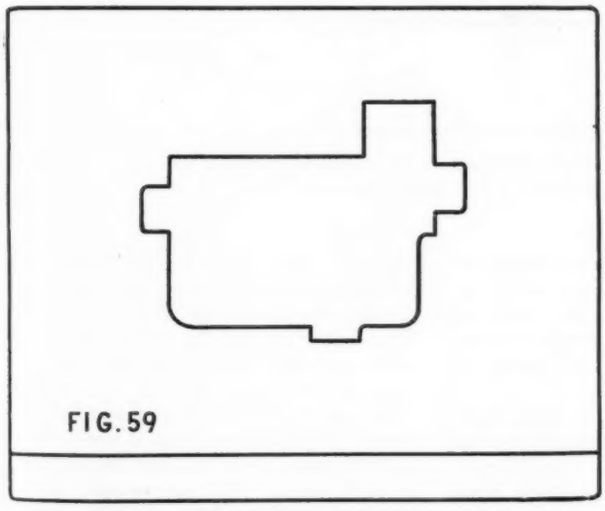
Several years ago it was found that many adding-machine parts had been changed slightly, and that trimming was done by hand filing. Two dies were laid out, as shown in Figs. 59 and 60, so that over a hundred different parts could be trimmed in the press. Each part was located in a nest plate on the die block, and was so placed that the contour of the punch at that particular spot would trim the piece to the desired shape and size. These tools did away with the expense and lack of uniformity prevailing with the filing method.

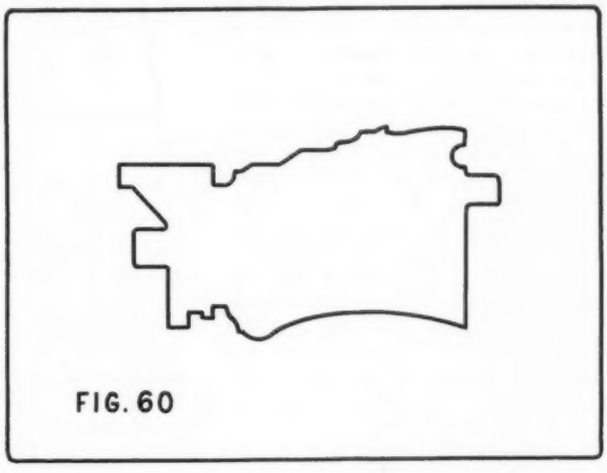
Considerable time and ingenuity were required by the die designer to place the radii and straight lines so as to cut only where desired. The square section at the center of each end of the die opening was for a heel on the punch to back up the cut. The die block was drilled and tapped all over for screws and dowels, and the most suitable ones were used in each set-up. These two dies were so successful that they were in the press practically all the time.

An example of a die that trims a part to a smaller size is shown in Fig. 61. The piece is a three-legged spider which goes into the line-space mechanism of an adding-machine carriage. The ends of the spider legs are trimmed off $\frac{1}{8}$ in. to suit a smaller model. Because of the low production, only a die of the planish-block type was needed. The part is located by the pin in the center and guided by the nest plate beside the prongs. The method of making this type of die was discussed in connection with Fig. 15 (*AM*—Vol. 80, page 377).

A section is trimmed out in a piece by the die shown in Fig. 62 in order to get clearance for another part. If it were not for the heel, the punch would spring sideways when cutting only on the one side. This condition would cause the edge of the punch and the die on the other side to be sheared.

This die is a universal type for which the general machining directions were given in connection with Fig. 8 (*AM*—





Figs. 59 and 60—By combining radii and straight lines the die designer was able to make two dies that could be used to trim more than 100 different parts. Each part is located by a suitable nest plate and is trimmed only at the specified portion

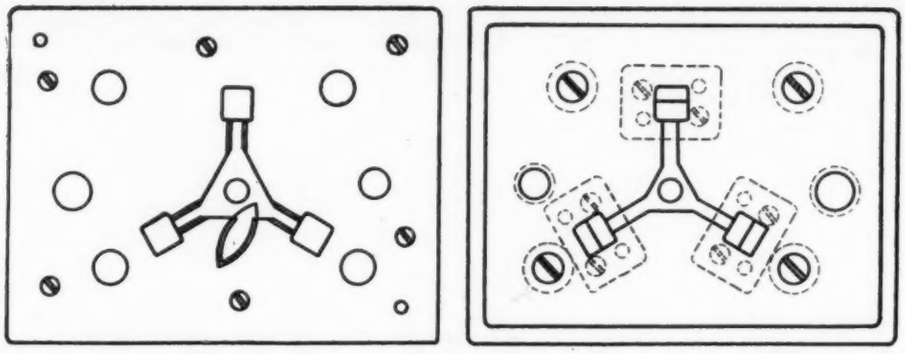
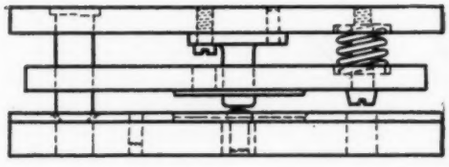
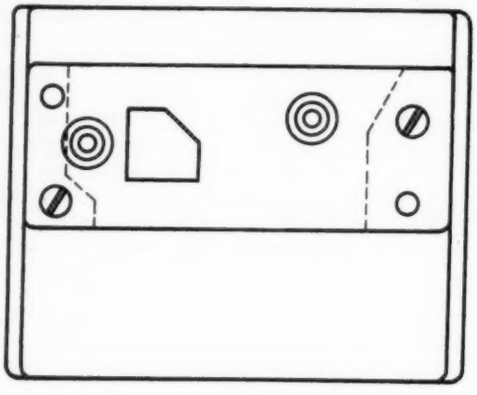
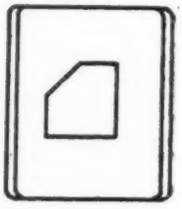


FIG. 61

Fig. 61—To trim the ends of the prongs square it is necessary to use a nest plate







Vol. 80, page 306). The part is located by the two holes placed over locating pins in the die block. A cold-rolled stripper removes the part from the punch. There is enough room under the stripper to get the work in and out over the locating pins.

Both trimming and piercing take place in the mounted die shown in Fig. 63. The part is a type sector for an adding machine, and one end is trimmed as shown, so that a tool steel heel can be riveted on. The part is located on two locating pins, one at *A* in the die block and the other at *B* on an extension.

The die block *C* was made of tool steel because the cutting edge for the trim is located in the die block. The piercing holes are bushed as the corners often round over or chip out on small holes, and it is cheaper to make a new bushing than a new die block.

A locating plate *D* was used to support the overhang of the part and to mount the locating pin. Without this plate the die block and the sub press would otherwise have to be large enough to reach the outer locating pin, and would be much more expensive. The plate *D* is set down in the die block as shown in the side view. When sharpening is done, the same amount is ground off the die block under the plate as is ground off the top in the working area. This extension plate is made of cold rolled-steel.

Equalizer buttons were used in this die to prevent the stripper from cocking up at one side during use. Because floating piercers were used, the punch plate and the stripper were bushed, and pilot pins and bushings

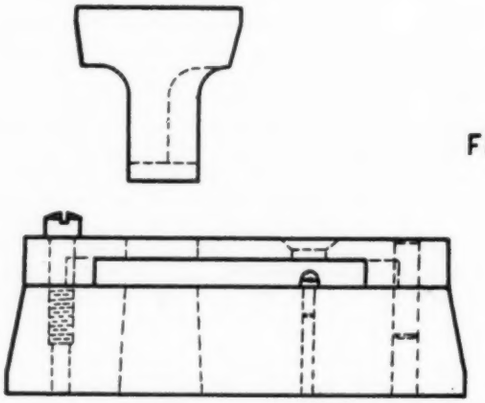


FIG. 62

Fig. 62—A heel must be used to back up the punch or else it will spring and shear the die

were employed. It was preferable in this die to mount the trim punch in the punch plate as shown, than to mount it directly on the upper member casting and to clear around it through the punch plate.

A notch is trimmed in a die-cast-aluminum, adding-machine cover case, as shown in Fig. 64. The case is placed over two locating pins with the top side resting on top of the die block.

The gray-iron casting *A* is machined on the lower end to fit the universal holders. The sides are finished for attaching locating straps and the top is finished for the die block. A hole is cleared through the center for the slug to drop out. Two buttons *B* support the outer part of the case. They are made of drill rod and hardened. The locating strips *C* are made of cold-rolled steel and hot formed to a right angle. They are screwed and doweled to the casting. In the outer ends are driven the locating pins to suit the holes in the case.

Die block *D* is made of tool steel.

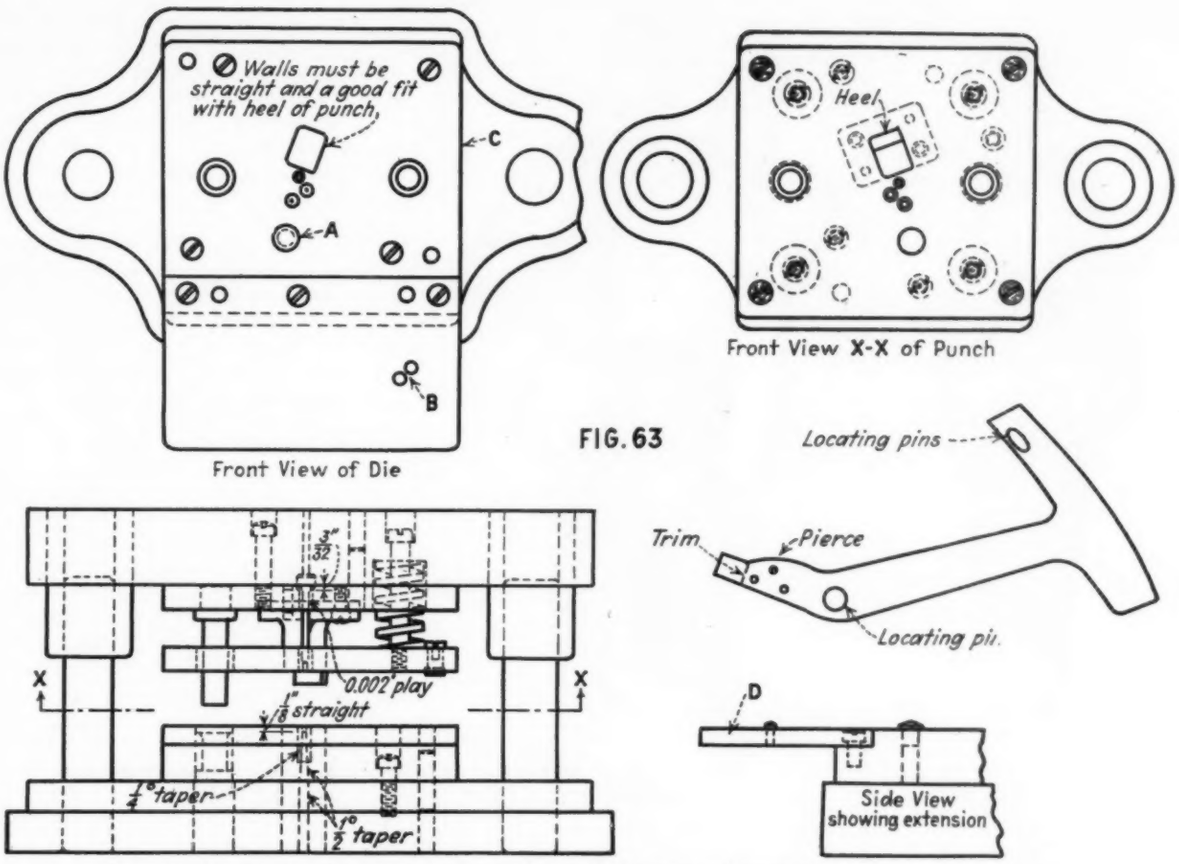


Fig. 63—An extension D supports the overhang of the part and saves the expense of a sub press and die block large enough to take in the entire piece

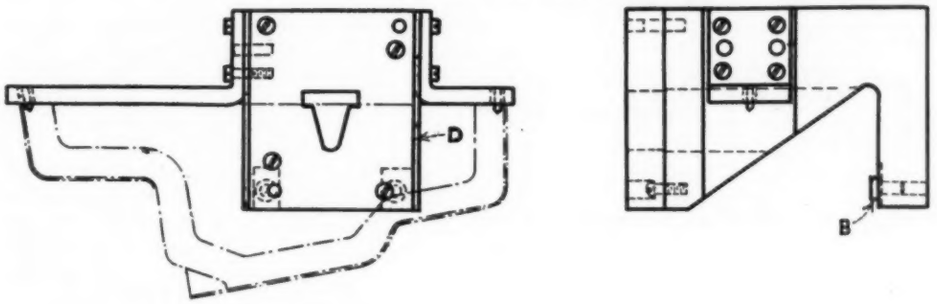


Fig. 64—Die block D is raised up to the proper height to trim a large die-cast cover by mounting the die block on a suitable cast-iron base

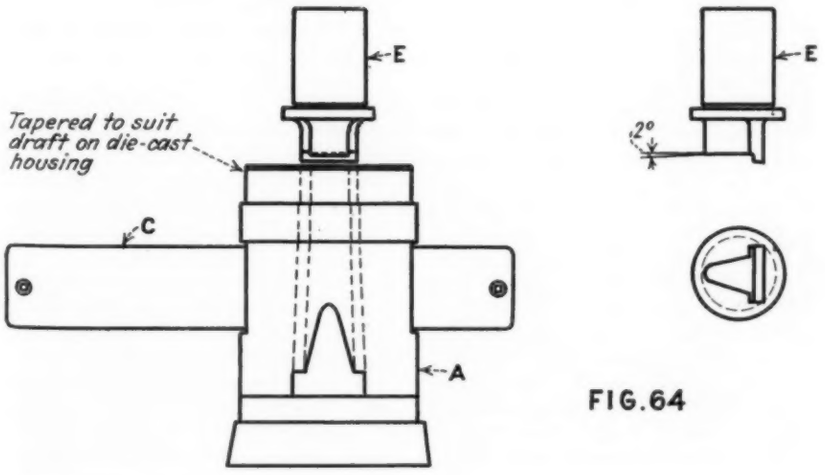


FIG. 64

and hardened and ground. The top is tapered to fit the inside draft of the die-cast case. The punch *E* is made of tool steel and hardened and ground. The top is machined to fit directly in the hole of the press ram, and the lower end is made a snug sliding fit in the die block. A heel is left on the rear of the punch to back up the cut.

IF THE WORKER ONLY KNEW—

Would he believe there are only so many jobs?

"I SEE the company is cutting costs, again, Bill. Where do they think we'll come out?"

The speaker is Sam, planer hand, and he is addressing his fellow worker, Big Bill, as they stow away sandwiches and coffee during the lunch period.

"What do you mean, 'cutting costs,' Sam? And even if they are, what does that have to do with us?"

"Well, it's perfectly plain to me. I saw those time-study men and the equipment engineer holding a pow-wow in the milling department this morning. And I know what that means—new machines that'll throw a couple of us fellows out on our ears. That's what it has to do with us."

"Now, Sam—I thought you'd got rid of those ideas. You know perfectly well *this* firm doesn't throw men out on their ears. A couple may be moved away from milling, but they'll still have good jobs. And if we don't cut costs, how can we keep our prices down to meet competition? And if we don't do that, how can we get the orders to keep anybody employed?"

"Oh, I know, Bill—the usual arguments. I guess you're right about keeping the men on here. But that means a couple extra men won't be hired. And if all the plants do that, a lot o' people won't have work. There's only so much work, anyway. Why not divide it up?"

"So that's what's eating you. Okay, I'll have to go over some of the old arguments. In the first place, there's no use putting those extra men on if it's going to raise costs. The higher the costs go, the less we sell and the fewer the jobs. We've got to *lower* the prices so we can sell more, in order to give those extra people work. And ——"

"But, Bill, what makes you think we can sell more? There's a limit to what can be used, you know."

"Yes, Sam, I suppose there is. But we haven't seen it yet—or anyway near it. Do *you* know anyone who has everything he needs or wants?"

"No, can't say I do. Can't say I see how they're going to get it, either."

"Here's one way, Sam, and I guess it's the only way: Keep improving methods and machinery so that we can get costs lower and lower. Reduce selling prices as costs go down. Then more will be sold, more will have to be made, and there will be more jobs."

"Sounds all right, Bill, but how *many* more jobs? Enough to really amount to something?"

"Sure. There's an easy way to measure it. Just think back to 1929—we didn't believe people lived too well then, did we?"

"No."

"Well, suppose we had 1929 standard of living today. Factories—and I mean *factories* alone—would have to make so many more products that they would employ between ten and eleven million people, instead of the less than nine million they now employ."

"Yes, that's a million and a half more jobs. What then?"

"All right. Suppose we raised everybody's standard of living 25 per cent. We'd put on another 2½ million. Then if we kept on going, getting the standard up to 50 per cent above 1929, we'd add still another 2½ million workers."

"That gets you up to where, Bill?"

"Right up to 15¾ million, Sam."

"And is that a lot?"

"I'll say it is. It's just about 5½ million more than factories employed in 1929—their best year. And it doesn't take into account other industry, and service occupations, and selling. There'd be a lot more jobs there, too, you know."

"I guess you've got me sold again, Bill. I suppose you got those figures out of some of the books you're always studying. Hope they're right."

"Yes, I did get them out of books. And they're right, I guess. At any rate I know they're based on government figures. There goes the whistle."

Editorials

AMERICAN MACHINIST ESTABLISHED 1877
VOLUME 80 NUMBER 19
K. H. CONDIT • F. H. COLVIN
EDITORS

MANAGEMENT HEADACHES

IF the New Deal has done nothing else it has at least given the managers of American business some major questions to worry about and to help them forget the minor annoyances of everyday plant troubles.

First comes the question of the new corporation surplus tax. If he has a net surplus shall the manager pay it all out in dividends and escape taxation? How much of a tax can he afford to pay if he wants to pay off some of the company debts? Or should he ask the bank to renew the loans?

Should he rebuild his reserves at the expense of a heavy tax penalty for so doing? How can he handle his depreciation reserve policy so that it will be accepted by the Bureau of Internal Revenue?

Assuming he still has a net income after the payroll taxes for social security have been deducted from the gross, how much is it wise to spend for advertising and research to reduce the net subject to surplus tax? Has he obsolete facilities that can be scrapped and written off to lower the tax liability? If so, when and how should they be replaced?

Then comes the matter of bids on government contracts under the terms of the Walsh-Healey Act. Can he keep within the ten thousand limit? If not, what hours must he work his men? Is there a minimum wage for his particular kind of work? What overtime rate is specified? What exceptions can he get from the Department of Labor? Is it worth while to bid on such contracts at all?

As for the Robinson-Patman Amendment all he has to do is to make sure that he makes the same prices and gives the same kind of terms to customers of equal status. Just how he is to determine what equal status means is something to keep a Philadelphia lawyer guessing. And he must be sure, of course, that he doesn't do anything to get better terms from a supplier than his competitor is getting.

Recent court decisions have pretty well relieved the concern over what the Wagner Labor Relations Act may do to him unless he is definitely engaged in interstate commerce. The article beginning on page 789 tells how the scope of the NLRB is being narrowed.

ALL of these worries ought to dwarf the problems of how to get enough trained men to turn out the orders, or how to train more against future needs, or how to pacify irate customers who demand immediate delivery of products that haven't been built. But probably they won't, for these problems are immediate and the others can be stalled off for a month or so.

Management today is just one headache after another, yet there are plenty who want to manage. Why, heaven knows.

Census Progress

EVERYBODY knows that the Bureau of the Census concerns itself with statistics but not so many know the statistics of the Bureau itself. For instance, did you know that fifty-three different sets of figures are collected and reported every month, most of them dealing with business or industrial facts? Or that the Bureau is doing its level best to shorten up the intervals on most of the trade statistics it is collecting and releasing? And to improve their accuracy?

Officials of the Bureau are anxious to get criticisms and constructive suggestions from industry to help them in improving the kind of service they are equipped to render. They want to know what statistics are needed that are not now being gathered, and what ones, now being gathered are not worth gathering.

They also point out that there is no law to compel the supplying of some of the information asked for by the Bureau. Their best appeal is to the sportsmanship of those who are more anxious to get statistics than to contribute to them. As for the confidential nature of Census statistics, they say merely that it is contrary to law to reveal any information supplied by an individual or a company, and that every Congress that has modified the laws applying to the question has made them more stringent. Furthermore, it should be perfectly clear that any leaks that might occur would soon defeat the whole purpose of the Bureau by making its promises unreliable.

One great improvement that is yet to be made is to concentrate all statistics gathering functions of the government into one central department to avoid duplication and needless annoyance of citizens who receive questionnaires. Business will be in favor of improving the service of the Census in supplying market data. Possibly, in the not too distant future, we shall have a Congress that will pay somewhat more attention to the needs and wishes of business.

Chips

WASHINGTON—Roosevelt talks about plans for bureau reorganization before starting south . . . Roper announces that Pan-American will start Pacific passenger service within two months as German test planes start Atlantic flights . . . Navy working on plans for battleships with 18-in. guns . . . Test of Federal Security Act is planned by New Jersey Social Security Commission which believes it to be unconstitutional . . . Roosevelt starts first Boulder Dam power unit . . . Associated Press takes Labor Relations Board test case to the Supreme Court . . . Republican slate victorious in Maine, and Landon continues his campaign tour . . . Senator Couzens, Republican, lost nomination for reelection following his declarations for Roosevelt reelection.

FOREIGN—Hitler boasts of rearming accomplishments before Nazi congress, renews attacks on Jews and Communists, insists Germany is eager to avoid all wars . . . Soviets fire factory chiefs in light industry plants for failure to maintain quality and production . . . French unions strike to force intervention in Spanish civil war as British unions vote to support neutrality . . . German and Russian propagandists call each other evil names but there seems to be little chance that anything more serious will follow . . . Food rationing plan in Germany being studied . . . France plans to strengthen Polish industry, foster modernization . . . Pope denounces Communists in address to refugee Spanish Catholics . . . British unemployables estimated at between 6 and 8 per cent of population . . . French government conciliators laboring to prevent Lille and St-Die textile strikes from spreading into metal working trades.

FINANCE—Treasury loan 9 times oversubscribed . . . London banks buying British government bonds, presaging financing of rearmament program on permanent basis.

INDUSTRY—Southern states have to stop WPA jobs to get enough labor to pick cotton crop . . . Buick to spend $15,000,000 more for improvement of manufacturing facilities . . . Kelvinator will spend $600,000 on new buildings for assembly and warehousing . . . President of Carnegie-Illinois subsidiary of U. S. Steel tells employee representatives industry cannot afford wage increase now, expresses willingness to consider any plan they offer by which it could be accomplished . . . Republic starts work on 1200-ton blast furnace at Cleveland to replace 20-year-old 600-ton unit . . . Boeing is building hammer shop at its Seattle plant . . . Leonard Ayres, Cleveland economist, finds steady business gains for three consecutive quarters . . . Roper predicts long-term upswing, warns against boom conditions . . . Baldwin Locomotive bookings gain sharply . . . General Electric puts profit-sharing for employes on semi-annual basis.

TRADE—Biggest radio show in years opens in New York . . . Machine tool orders off 15 per cent during August, as foreign orders sag a third.

INDICATORS—Steel production up to 72.5 per cent of capacity . . . Electric output at 202.9 and *Business Week's* index slightly off, at 75.7, reflecting normal Labor Day holiday recession.

Gear Makers Take to Lakes

ABOARD THE S.S. SEEANDBEE—Piloted by President Sawtelle, Tool Steel Gear and Pinion Co., the American Gear Manufacturers' Association celebrated its nineteenth semi-annual meeting by floating for three days across the Great Lakes. Drifting from Chicago about noon Sept. 8, 125 members, wives and guests finally landed at Cleveland on the evening of Sept. 10.

Meetings, dinners, dances, deck games and other sports claimed the attention of the voyagers. The morning of September 9 was spent on historic Mackinac Island with its diversity of attractions. But the pleasurable aspect of the cruise did not eclipse the more serious purpose of the meeting; technical and commerce papers were presented in their customary number and quality.

In greeting members and guests, President Sawtelle stressed the functions of trade associations in general and the A.G.M.A. in particular. He stated it was the job of the Association to help members help themselves rather than to seek solution of their problems by legislation or regulation.

Quiet in Gearing

The first session started on a quiet note with W. P. Schmitter's address on "Quiet High Speed Gearing." Mr. Schmitter, who is with the Falk Corporation, has contributed valuable technical information to A.G.M.A. meetings previously. In his outline of the disturbances that cause gear noise, he carefully distinguished between those wholly or partially under the control of the engineer and those which were the chief concern of the shop.

J. Harper Jackson, Pittsburgh Gear & Machine Co., who has for a number of years served as A.G.M.A. treasurer, told the assembly about "Increasing Our Earnings." He pointed out that, because of legislative and other influences, prices are still rising and that it is essential for manufacturers to recognize cost trends if their businesses are to keep on a sound basis.

"Waste Prevention, Reclamation and Salvage" was the subject of a paper delivered by T. H. Owens, Westinghouse Electric & Manufacturing Co. Modern tendencies toward rapid change in style and design, according to Mr. Owens, has increased the manufacturer's problem in curtailing losses from obsolete and inactive stock.

A. H. Candee, Gleason Works, gave an excellent picture of "Recent Developments in Bevel and Hypoid Gearing." Hypoids, Mr. Candee showed, have the advantages of lowered or raised shafts, bearings on both ends of the shafts and the possibility of multiple drives by mounting a number of pinions on a continuous shaft. The speaker also described the "Formate" gear made by a nongenerating process using a new machine and a new cutter.

Another technical presentation was made by C. B. Connell, Westinghouse Electric & Manufacturing Co., in his paper on "Relations Between Load Rating and Design Stresses of Gear Units." Dangers of following set formulas were pointed out by Mr. Connell who showed the necessity of considering prime mover and driven machine in designing proper gearing for the job.

In addition to the above, two papers on economic subjects which had previously been delivered before other associations were read and distributed to the members. These were "Industry's Contribution to Civilization" by S. Wells Utley, president, Detroit Steel Castings Co., and "We're on Our Way —to What?" by Charles R. Hook, president, the American Rolling Mill Co.

Growth of the A.G.M.A. was reported by Membership Committee Chairman L. R. Botsai, Nuttall Works, Westinghouse Electric & Manufacturing Co., on whose recommendation the following new members were elected: Chicago Gear Manufacturing Co. and Mechanical Specialties Manufacturing Co., to company membership; Reliance Electric & Engineering Co., United States Electrical Manufacturing Co., and Otis Elevator Co., to associate membership; Prof. H. C. Hesse, University of West Virginia to academic membership.

Dingle Describes Exposition

As in all recent meetings, smoothness of schedules and general good management were due largely to the association's secretary, J. C. McQuiston. Howard Dingle, Cleveland Worm & Gear Co., described the Great Lakes Exposition, for those members of the party who planned to pay it a visit upon disembarking at Cleveland.

Outstanding events: scheduled demonstration of free-hand bicycle riding by General Electric's A. A. Ross and Boston Gear Works' Harry Kerr; three times encirclement of Mackinac Island, in three hours, afoot, on bicycle and via speed boat by Mr. Botsai.

A.G.M.A. Pilot

E. S. SAWTELLE

Overseas Engineers Meet With A.S.M.E. at Niagara

World Power Conference Delegates Inspect Plants at Niagara Falls

More than 400 touring delegates, attending the world Power Conference, Washington, D. C., met at Niagara Falls during the meeting of the American Society of Mechanical Engineers, Sept. 17 to 19, and took part in the technical discussions. The major part of the program was devoted to power and hydraulics, in line with the principal interests of the visitors.

Members and guests were entertained Thursday evening at a dinner sponsored jointly by the A.S.M.E. and the Niagara-Hudson Power Co. President W. L. Batt of the Society welcomed the overseas guests on behalf of the American engineers.

Before the regular meeting began, the executive committee of the A.S.M.E. council, and senior councillors met to discuss Society affairs and to take stock of the results of the plan by which the senior members are keeping in touch with the work of local sections of the Society.

TO EXPLAIN STANDARDIZATION

Engineering and management aspects of industrial standardization will be discussed during the next two months in a series of eight illustrated lectures by Dr. John Gaillard, a member of the staff of the American Standards Association, 29 West 39th St., New York.

Explains Fixture Design Before Tool Engineers

C. J. Martin Delves Into His Wide Experience at Detroit Session

Machine tool and fixture design was discussed in a paper by Charles J. Martin, Ex-Cell-O Aircraft & Tool Corp., Detroit, at the meeting of the American Society of Tool Engineers in Detroit on Sept. 10. For many years he was assistant chief draftsman of the tool and machine design department, Ford Motor Co.

J. J. OLLER DIES

Since 1910 president of Landis Machine Co., Waynesboro, Pa., J. J. OLLER, 81, died at his home September 3. He had been active in both the industrial and community welfare work of Waynesboro for many years.

PERSONALS

F. A. BOWER, who last spring retired because of ill health as chief engineer of Buick Motor Co., has sailed for Europe to give technical advice to General Motors overseas operations.

LAURENCE C. BOWES, formerly general piece work supervisor, Chicago, Rock Island & Pacific, has been appointed to the new position of engineer of shop plants and machinery, with headquarters at Chicago.

Lukens General Superintendent

G. DONALD SPACKMAN

Formerly president of Lukenweld, Inc., division of Lukens Steel Co., Coatesville, Pa., G. DONALD SPACKMAN has been named general superintendent of the parent company. LESTER M. CURTISS, who a few months ago was appointed superintendent of production, will continue in charge of all production.

A. R. ELLIS, who since his graduation from Cornell University in 1905 has been with the Pittsburgh Testing Laboratory, Stevenson and Locust Sts., Pittsburgh, has been elected president of the company.

E. E. GEISSEL, production executive of Four Wheel Drive Auto Co., has been appointed manager of the company's parts and service departments.

JOHN PFEIFFER, superintendent of motive power, Ft. Worth & Denver City Railroad, has been appointed to the same position on the Colorado & Southern, succeeding H. W. RIDGEWAY, retired, in addition to his other post.

P. C. WITHROW, formerly mechanical engineer, Denver & Rio Grande Western Railroad, has been advanced to acting mechanical superintendent of the line with headquarters at Denver.

BUSINESS ITEMS

Eisler Electric Corp., Union City, N. J., has acquired the interests of Bissett Steel Co. and George Bissett in the Tungsten Electric Corp., which now becomes a division of Eisler, C. L. Laise, president, announced.

Ex-Cell-O Aircraft & Tool Co., 1200 Oakman Ave., Detroit, has appointed Herberts Machinery Co., Ltd., 2929 Santa Fe Ave., Los Angeles, its exclusive sales representative in southern California.

H. E. Eaton Co., Eastern sales representatives for New York and New England for Michigan Tool Co., Colonial Broach Co., and Detroit Tap and Tool Co. have been moved to 51 East 42nd St., New York.

Federal Products Corp., 1144 Eddy St., Providence, R. I., has opened a Chicago office at 400 West Madison Ave., in charge of W. E. Carroll.

Groov-Pin Corp. has moved to larger factory quarters at 411 Kerrigan Ave., Union City, N. J.

Machine Tool Orders Show Summer Decline

Foreign Orders Drop Sharply, But 3 Month Average Climbs

A normal summer recession in domestic machine tool orders and about a third less foreign orders received during August, dropped the National Machine Tool Builders' Association index of orders to 127.5, compared with 150.1 in July.

The three months trend continues upward, however, standing at 135.5 against 132.6 during the previous month, and is still at the highest level it has been since 1929.

Table I—Index of Machine Tool Orders

Based on Volume of Shipments for 1926

Month	Index of Orders			3 Months' Average Index	% Foreign to Total Orders
	Domestic	Foreign	Total		
1935—May	57.3	16.0	73.3	67.1	21
June	75.5	15.6	91.1	76.7	17
July	82.5	37.3	119.8	94.7	31
August	78.2	47.6	125.8	112.2	37
September	54.1	25.9	80.0	108.5	32
October	79.5	23.4	102.9	102.9	23
November	79.2	19.4	98.6	93.8	19
December	78.1	20.2	98.3	99.9	21
1936—January	95.7	15.1	110.8	102.6	14
February	99.8	12.3	112.1	107.1	11
March	89.0	16.3	105.3	109.4	15
April	110.9	14.8	125.7	114.4	12
May	95.7	23.2	118.9	116.6	19
June	106.5	22.3	128.8	124.4	17
July	104.4	45.7	150.1	132.6	30
August	96.1	31.4	127.5	135.5	24

Table II—Distribution of Orders

Average Indexes of Individual Companies	Companies in Per Cent of Total Number Reporting							
	1935 by Quarters				1936			
	1st	2nd	3rd	4th	1st Quar.	2nd Quar.	July	August
200-up	40.2	5.8	14.2	11.3	13.0	17.2%	19.3%	16.8%
100-199	12.5	15.8	22.1	24.3	24.6	32.6	28.3	29.2
60-99	16.9	22.0	17.2	21.7	22.4	19.0	26.2	21.9
20-59	39.6	31.2	31.6	27.7	26.5	21.8	17.2	21.9
Less than 20%	26.8	25.2	14.9	15.0	13.5	9.7	9.0	10.2
		100.0	100.0		100.0	100.0	100.0	100.0

Watching Washington

Maine election, state primaries, and straw polls cheer G. O. P. . . White House denies link to Communists . . . Supreme Court to review more New Deal laws . . . Railroads and shipping studied

WASHINGTON—Republican supporters, who faced a return of their preconvention pessimism, are taking heart at resent turns of affairs. For things are happening to promote the Kansan's cause, psychologically as well as politically.

At Cleveland in June, G.O.P. chances were turned from a forlorn hope into an enthusiastic possibility with the clear-cut nomination of Governor Landon. This wave of spirit was allowed to cool, as even Republican National Chairman Hamilton admits. August saw something of a return of early defeatism in Republican ranks, but now there are definite signs of new vigor and new zeal in its stead.

The election in Maine and primaries in other states have looked good to Landon advocates. Vainly do Democrats deny that the nation follows Maine and point to Democratic Governor Brann's close contest. Whether or not the Maine myth holds water, there is concrete satisfaction for Republicans in seeing Republican votes shower down. And, after all, say they Governor Brann is an anti-New Dealer whose personal popularity put him ahead of his ticket.

Couzens Defeated

Michigan returns, too, swelled Londonites' hopes in the primary defeat of Senator James Couzens. It was generally foreseen that the veteran G.O.P. senator had cut his political throat in climbing on the Roosevelt bandwagon, but the 314,000 to 191,000 victory of former Governor Brucker gave plain notice that the great majority of Michigan Republicans want no temporizing with the New Dealism.

In the Massachusetts primary, Republican votes topped those of their opponents 419,000 to 387,000 in a senatorial contest which named Henry Cabot Lodge, Jr., and Governor Curley as candidates. In this state internal strife may further harm the Democrats.

Straw polls are another source of G.O.P. satisfaction. That being made by the *Literary Digest,* while admittedly still in its early stages, gives Governor Landon about 60 per cent of over 250,000 votes. Doctor George Gallup's Institute of Public Opinion returns, on the other hand, show 52.6 per cent and a majority of the electorial votes for the President. Closeness of the contest is indicated by the fact that fifteen of the states are listed as borderline, or within 3 per cent of a 50-50 division of ballots.

Denies Hearst Attack

That the White House knows and feels these trends is reflected in a statement by Stephen T. Early, presidential secretary, which denounces the fact that "a certain notorious publisher" seeks to give the impression that the "President passively accepts the support of alien organizations hostile to the American form of government."

Sunday papers of William Randolph Hearst, to whom the Early statement obviously referred, quote Earl Browder, Communist nominee for president, as saying, "We, the Communists, can join in such a common front with the workers supporting Roosevelt." Whatever may be the political repercussions of the Hearst attacks the quick reply from the White House shows a certain touchiness to the current situation.

But before the election, another event will take place which may have just as far-reaching effect in the laws of the country. This is the convening of the Supreme Court on October 5 to face a docket containing cases challenging certain New Deal statutes. This term should see decisions on the new Frazier-Lemke Farm Moratorium Act, the National Labor Relations Act, The Railroad Retirement Tax Act, The Commodity Exchange Act and the government authority under Title II of NIRA to make grants and loans for municipal power plants which will compete with privately-owned utilities. Other pending cases which do not, however, involve constitutional issues, are the Security Exchange Act, the Public Utility Holding Company Act, the Social Security Act and the Federal Communications Act.

As a revival of business, such as took place in 1915 is regarded as possible, Federal studies of the mistakes that were made at that time are underway. By pointing out the pitfalls which business encountered at that time, it is hoped that similar ones may be avoided as business gathers momentum.

Insofar as machinery is concerned, the study at present is confined to the experience of the railroad and ship-building industries in the 1914-1919 period. The mechanical plant of the railroads of 1914 is being compared with the situation today. The weak spots developed two decades ago, as the transportation set-up was being called upon for greater performance, will be studied for lessons that will apply to the growing demands now being made on the railroads.

One objective of the ship-building study is to determine how well the country is prepared to launch upon a large ship-building program. It is being taken for granted that, under the new Merchant Marine Act, American shipping will be rehabalitated. The Navy feels that this is necessary for national defense.

The ship-building program which began twenty years ago was accompanied by great waste, and fundamental mistakes were made. Since nearly twenty per cent of the money that goes into a ship is expended for machinery, the study will attempt to determine if the makers of the machinery that will be needed are in a position to meet requirements without delaying the program.

V. F. W. Promotes Defense

The Veterans of Foreign Wars have just organized a new post which will take leadership in pushing a program greatly to increase the air defense of this country. Named after General William Mitchell, the new post will organize committees in the 3,500 V.F.W. posts throughout the United States. The program, if adopted by the government, would result in the purchase of almost 4,000 new planes by 1939. Further recommendations provide for the building of additional warships equal to the fleet of the strongest nation, in event that present naval treaties are violated.

14 Technical Papers In S. A. E. Aircraft Meeting

First Nation Production Gathering of Aero Engineers Oct. 15

The program of the first national Aircraft Production meeting which will be held at Los Angeles, Oct. 15 to 17, by the Society of Automotive Engineers and its four Pacific Coast sections, with the cooperation of the Aeronautical Chamber of Commerce and the Air Transport Association, includes important metal-working papers. Fourteen technical papers, a large number of written discussions and plant and laboratory visits will feature the meeting.

The program:

Operation and Maintenance

Chairman: W. A. Hamilton, system maintenance superintendent, T.W.A., Inc., Kansas City, Mo.

"Maintenance and Overhaul of Naval Aircraft," by Commander F. W. Pennoyer, U. S. Naval Air Station, San Diego, Calif.

"Some Problems in Testing Planes for Airline Operation," by M. G. Beard, test pilot, American Airlines, Santa Monica, Calif.

"Maintenance Problems of Trans-Oceanic Flying Boats," by C. H. Schildhauer, operation manager, Pacific Division, Pan American Airways, Alameda, Calif.

Factory and Equipment

Chairman: E. J. Rivers, general superintendent, Airplane Development Corp., Glendale, Calif.

"Equipment of an Aircraft Factory for Medium Production," by R. C. Von Hake, superintendent, Lockheed Aircraft Corp., Burbank, Calif.

"Aircraft Spotwelding," by Bruce Burns, designing engineer, Northrop Corp., Inglewood, Calif.

Engine Session

Chairman: W. B. Goodman, field engineer, West Coast, Wright Aeronautical Corp.

"Selection of Oils for High Output Aircraft Engines," by A. L. Beall, research engineer, Wright Aeronautical Corp., Paterson, N. J.

"Aircraft Engine Installation Vibration Problems," by John Tyler, Lycoming Mfg. Co., Williamsport, Pa.

"Radial Aircraft Engine Production," by J. Carlton Ward, Jr., assistant general manager, Pratt & Whitney Aircraft Corp., East Hartford, Conn.

Aircraft Materials and Processes

Chairman: L. H. Steward, Bureau of Air Commerce, Los Angeles Municipal Airport.

"Designing for the Use of Aluminum Alloy Forgings and Extrusions in Aircraft Production," by Howard Houghton, chief draughtsman, Douglas Aircraft Co., Santa Monica, Calif.

"X-Rays and Gamma Rays—Their Industrial Application," by T. A. Triplett, Triplett & Barton, Los Angeles, Calif.

"Large Scale Production Economies from Small Production Tools," by George H. Prudden, Lockheed Aircraft Corp., Burbank, Calif.

Government Design Requirements

Chairman: C. E. Stryker, chief engineer, Curtiss-Wright Technical Inst., Glendale, Calif.

"Factory Facilities and Federal Regulations," by Richard C. Gazley, chief engineer, Manufacturing Inspection Service, Bureau of Air Commerce, Washington, D. C.

Inspection Trip

Trip to California Institute of Technology.

Production Design Session

Chairman: Hall Hibbard, vice-president and chief engineer, Lockheed Aircraft Corp., Burbank, Calif.

"Design and Construction of Large Aircraft," by R. J. Minshall, John K. Ball and F. P. Laudan, Boeing Airplane Co., Seattle, Wash.

"Designing to Please the Traveler," by A. E. Raymond, vice-president in charge of engineering, Douglas Aircraft Co., Santa Monica, Calif.

Industrial Review

• **DURING** the first two weeks of September, orders for machinery and machine tools dropped off somewhat in most of the important industrial centers of the country. Some correspondents attribute the decline to politics, others to the end of the vacation season. Factories are busy with substantial backlogs of orders.

• **BOSTON** reports in the New England territory that business was excellent through the first week in September. A sudden drop then is attributed to the uncertainty of the outcome of the Maine election. Word from New York distributors is to the effect that business has kept up very well and that the volume is satisfactory in the metropolitan district. The machine tool business is good in the Philadelphia territory, but the outcome of the RCA Camden strike is that certain products are being moved out of the territory. Pittsburgh correspondents do not believe any serious labor trouble will break out there until after election. Agitators are apparently concentrating on the small plants. Inquiries are good, orders fair.

• **IN CLEVELAND** business is continued at a satisfactory level, and there is every expectation that it will continue so for many months. Employment is improving, and there is no immediate danger of labor trouble. Detroit reports an increase both in inquiries and in orders caused by a realization on the part of buyers that immediate deliveries are out of the question. There is no labor trouble on the surface. Things are quieter in Indianapolis than they have been for several months, but inquiries are strong. Observers are inclined to think that the drop may be caused by politics.

• **WHILE** there has been a slight letdown in orders received by some companies in Cincinnati, others report a steady increase and the general level is high. No new labor trouble has broken out, but the situation is touchy. There is no change of any moment in the St. Louis situation either in the way of orders or of labor difficulties. The shortage of skilled men is still bothersome. Railroad buying is helping the machine tool market according to Chicago sources, but other branches of the market are also contributing a satisfactory share.

• **IN MILWAUKEE** inquiries are strong, but there has been a pronounced drop in the number of orders taken during the last few days. There are no labor troubles to amount to anything and the manufacturers have plenty of work to keep their plants occupied for months to come.

OBITUARIES

ARTHUR N. BLANCHARD, 63, a founder and president of the Milwaukee Metal Working Co., Milwaukee, died Aug. 11.

HORACE COATES COLEMAN, 70, vice-president, Wildman Mfg. Co., knitting and special machinery manufacturer, died in New Hampshire Aug. 11.

W. C. DILLINGHAM, chief of the tool design section, experimental division, Packard Motor Car Co., Detroit, died recently.

ROBERT W. ELLINGHAM, 68, works manager, Stevens-Waldron Co., Worcester, Mass., hardware manufacturer, died Aug. 22. He was a founder of the Indian Motorcycle Co.

JOHN GILL, 80, former plant manager, American Locomotive Co., Dunkirk, N. Y., died Aug. 25. He was more recently superintendent of motive power, Chicago, Rock Island & Pacific Railroad.

GEORGE T. HAYNES, since March 1, 1935, superintendent of Apollo Steel Co., Apollo, Pa., died recently.

RALPH B. MANLEY, 56, president, Abrasive Machine & Supply Co., Newark, N. J., died Aug. 24.

GEORGE W. PEGG, general superintendent, Accurate Tool Co., Detroit, died Aug. 21.

SIR MARMADUKE WINTER, 80, president, Standard Mfg. Co., Ltd., and United Nail & Foundry Co., Ltd., St. Johns, Newfoundland, died Aug. 12.

JOHN GRIBBEL, 28, president, American Meter Co., Philadelphia, died Aug. 28.

Motors AND OTHER MATTERS

Factories are under pressure to build cars . . . Proponents chary about automatic transmissions . . . Bigger and better cars is trend, as manufacturing efficiencies keep costs low . . . 1938 designing is now underway

BURNHAM FINNEY
Western Editor

DETROIT—The automobile industry is in a hectic period as production executives are working day and night to whip manufacturing operations into shape for a smooth flow of assemblies. Pressure is being applied to over-burdened machine tool builders to make deliveries and motor car plants are being started department by department as tooling is completed. Hand-made pilot cars are being run down assembly lines to see that everything is in working order and that assemblies fit each other, part by part. These pilot cars cost from $4,000 to $6,000 each.

Eliminating "Bugs"

Some car makers are slower than anticipated, in launching into 1937 work, because they want to make sure that no "bugs" develop once production starts, and because equipment builders can't meet delivery dates as easily as during depression years. October, however, will see all companies turning out a sizable volume of new models. Whether output next month will equal the 280,316 units of October, 1935, depends on how quickly Ford, Chevrolet and Plymouth swing into line. Fourth quarter assemblies probably will match or exceed the 1,107,183 cars made in the final quarter a year ago.

Studebaker's and Packard's speed in easing full operations on 1937 models has irked Buick, a direct competitor, a bit. Buick has ordered "full speed ahead" and is planning to show cars to dealers and distributors early in October with a public announcement after the middle of the month. It anticipates the biggest payroll in its history in the coming quarter. Relatively conservative in design, they will reflect the growing trend toward more flowing lines. The automatic transmission to be made in the new transmission plant at Flint will be offered as optional equipment at extra cost by Oldsmobile and Buick. Operations, however, may not be far enough along to permit announcement of the new transmission at the beginning of the new Buick season. Remembering ill-fated free wheeling, which went out of favor about as fast as it came in, the industry is chary about forcing any new ideas down buyers' throats. Veteran drivers don't want their driving habits disturbed. Automobile people expect to secure support for such features from women drivers. Buick, by the way, is installing gear cutting machines of its own design which are attracting attention of tool builders.

Piston Fight Continues

Bohn appears to be waging a valiant campaign with its autothermic aluminum piston, which it claims is more efficient and saving in oil consumption than previous aluminum pistons. Graham adopted this piston in the middle of its 1936 production run and Packard is specifying it for 1937 cars. Two other car makers intend to use it this year. Aluminum cylinder heads, too, are under fire. Federal Mogul has introduced a copper alloy head which has proved its worth in trials with Ford V-eight motors. Briggs Mfg. Co. is said to have a pressed steel welded cylinder head ready.

The 1937 models reveal that the industry still has faith in building bigger and better cars. Wider bodies will be the rule.

Strangely, retail car prices probably will cling to the present level. A car owner will be paying less for his car than the past year, because he will be getting more for his money. That doesn't necessarily mean that the profit margin per car is to take a nose-dive. The ingenuity of automotive production men is being utilized to cut costs by installing time-saving machinery. One company, cuts axle gears five times faster than heretofore. Interchangeability of parts, particularly bodies, decreases costs tremendously. Packard admits that the semi-centrifugal clutch, transmission, steering gear, independent front wheel suspension, springs and rear axle, as well as other parts, are identical on the One Twenty and Six.

Car weights in 1937 will vary from 28 to 35 pounds per horsepower. Engineers could readily produce a car with a horsepower for every 18 pounds, with an aluminum cylinder block, although this now is remote.

Studebaker is the first of the new season to ballyhoo the hypoid rear axle. Hypoids, however, may give the industry a headache before it is through with them, because they require a special lubricant not carried generally by dealers and service stations. If car manufacturers don't do a thorough educational job quickly in convincing retail outlets to stock this lubricant, they are in for plenty of grief from owners complaining of rear axle trouble. Innocently buried in Studebaker's announcement of its new cars is a statement which is poison to oil companies. It says that the Fram oil and motor cleaners are standard equipment on all cars and motorists will be advised that oil need never be changed (except for summer and winter seasonal changes) if a new cartridge is installed whenever the dip-stick shows the oil is dirty. Studebaker Presidents have automatically selective overdrive transmissions as standard equipment.

Auto Show November 11

The industry plans a big splurge at the national automobile show in New York opening Nov. 11. General Motors again will have its special exhibits at the Waldorf, and Ford will present its own show at the Astor beginning Nov. 14, and Chrysler will have an exhibit at the Chrysler Bldg.

While car makers seemingly have their hands full smoothing out '37 production difficulties, designing departments are working overtime on 1938 cars. To make sure that the left hand doesn't know what the right hand is doing, the new quarters of the General Motors art and color section is being divided into secret shutaway offices with employees barred from every office except their own.

Train Will Display Industrial Products

Connecticut Venture Will Show Output of 22 States

The Connecticut Industrial Display Train will leave Hartford, Oct. 3 to show a wide variety of Connecticut-manufactured products in 22 states and 1,500 cities. Capt. Eric Foster Storm, Meriden, formerly traveling representative for Trumbull Electric Co., Plainville, is manager.

ORDNANCE MEN ELECT

BENEDICT CROWELL, Cleveland, assistant secretary of war and director of munitions during the World War, was reelected president of the Army Ordnance Association, Mills Bldg., Washington. COL. WILLIAM W. COLEMAN, president, Bucyrus-Erie Co., South Milwaukee, and COL. FREDERICK H. PAYNE, chairman, Greenfield Tap & Die Corp., Greenfield, Mass., were elected vice-presidents. Directors elected were COL. FRANK A. SCOTT, Cleveland, COL. ROBERT P. LAMONT, secretary of commerce in the Hoover cabinet, and COL. CHARLES L. HARRISON, chief of ordnance, Cincinnati Ordnance district.

MEETINGS

AMERICAN SOCIETY OF METALS, 18th Annual Convention, Oct. 19-23, Cleveland. (See National Metal Show, below).

AMERICAN WELDING SOCIETY, Oct. 19-22, Hotel Cleveland, Cleveland. Miss M. M. Kelley, secretary, 29 West 39th St., New York.

DAIRY & ICE CREAM MACHINERY MANUFACTURERS ASSOCIATION, Oct. 12-17, Atlantic City, N. J. Roberts Everett, vice-president, 232 Madison Ave., New York.

INTERNATIONAL ACETYLENE ASSOCIATION, 37th Annual Convention, Nov. 18-20, St. Louis.

NATIONAL METAL SHOW, Annual Exposition, Oct. 19-23, Lakeside Exposition Hall, Cleveland. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

NATIONAL SAFETY COUNCIL, INC. 25th Congress, and Exposition, Oct. 5-9, Atlantic City, N. J.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC., Aircraft Production Meeting, Oct. 15, 16 and 17, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 West 39th St., New York.

TWELFTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, Nov. 30—Dec. 5, Grand Central Palace, New York, Charles F. Roth, manager.

EXPORT OPPORTUNITIES

Machinery for making paper lined coffee bags, and packaging equipment. (Purchase.) Oslo, Norway. *1468.

Tile and brick manufacturing machinery and equipment. (Purchase.) Lima, Peru. *1472.

Cap-fastening machines. (Purchase.) Lourenco Marques, Portugese East Africa. *1479.

Fish canning and packing machinery and equipment, and fertilizer manufacturing equipment. (Purchase.) Lima, Peru. *1471.

Gas plant equipment. (Purchase.) Beirut, Syria. *1473.

Nitriding plant for plastics manufacture, hydraulic press and cutting equipment for celluloid. (Purchase.) Calcutta, India. *1469.

Precision instruments. (Agency.) Lima, Peru. *1484.

Aircraft instruments and accessories. (Agency.) Sydney, Australia. *1538.

Condensing units and compressors for refrigerators. (Agency.) Bahia, Brazil. *1536.

Jig saws, electric. (Purchase.) Tel-Aviv, Palestine. *1533.

Air-conditioning equipment, wind mills. (Agency.) Habana, Cuba. *1516.

Tinplate and can manufacturing machinery. (Purchase.) Shanghai, China. *1517.

Cylindrical cardboard container machinery. (Purchase.) Santiago, Chile. *1518.

Casein separators and preparation machinery. (Agency.) Johannesburg, South Africa. *1520.

Printing presses, automatic; hand-operated numbering machinery. (Purchase.) Singapore, Straits Settlements. *1531.

Sewing machines, hand. (Purchase.) Accra, Gold Coast, Africa. *1525.

* Interested American firms and individuals may obtain the names and address of the foreign firms making these inquiries upon application to the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington, or any district or cooperative office. Please refer to key number.

Exports of Machinery During July, 1936

	July 1936	June 1936	July 1935
Electrical machinery and apparatus	$8,042,542	$7,396,218	$6,241,906
Power generating machinery (except automotive and electric)	1,089,668	654,773	683,136
Construction and conveying machinery	1,185,424	1,076,668	1,106,375
Mining, well and pumping machinery	3,091,118	2,530,851	2,335,368
Power-driven, metal-working machinery	2,885,815	2,431,944	2,105,069
Other metal working machinery	267,553	283,549	153,524
Textile machinery	1,267,961	641,710	782,630

Exports of Metal-Working Machinery During July, 1936

	July 1936	June 1936	July 1935
Engine lathes	$105,843	$135,983	$105,986
Turret lathes	116,519	126,194	49,429
Other lathes	79,224	89,990	99,700
Vertical boring mills and chucking machines	74,178	92,364	115,966
Thread cutting and automatic screw machines	61,961	110,519	90,393
Knee and column type milling machines	129,810	68,220	72,827
Other milling machines	184,355	144,279	175,184
Gear cutting machines	154,541	49,170	181,564
Vertical drilling machines	76,824	74,071	41,877
Radial drilling machines	21,828	2,341	17,175
Other drilling machines	163,547	147,394	62,445
Planers and shapers	44,028	25,569	67,464
Surface grinding machines	57,587	63,128	31,671
External cylindrical grinding machines	74,330	90,434	49,703
Internal grinding machines	37,632	74,330	51,530
Tool grinding, cutter grinding and universal grinding machines	167,499	105,823	72,964
Other metal grinding machines	67,882	60,645	43,515
Sheet and plate metal working machines	328,959	194,704	129,762
Forging machinery	173,393	105,182	114,316
Rolling mill machinery	215,109	263,418	284,380
Foundry and molding equipment	79,558	46,344	25,166
Other power-driven metal-working machinery and parts	471,208	361,842	222,053

Other Metal-Working Machinery

Pneumatic portable tools	75,298	96,607	51,300
Other portable and hand and foot operated metal working machines and parts	79,778	85,846	49,013
Chucks for machine tools	13,190	14,387	18,191
Milling cutters, machine operated threading dies and taps and similar machine-operated metal cutting tools	68,313	35,871	25,137
Other metal-working machine tools	39,974	50,838	9,883

American Machinist REFERENCE BOOK SHEET ©

Bronze Welding of Cast and Malleable Irons

The term "bronze welding" is understood by the practical welding operator to refer to the joining of the high melting point metals, such as cast iron, nickel and copper, by the use of bronze weld metal. Although the average welding operator is familiar with this process, its fundamentals are probably not as thoroughly appreciated as are the fundamentals of fusion welding. Therefore, it is desirable to discuss the general principles and to include the various items of the procedure.

A brief discussion of the composition of bronze welding rods will be helpful. In the first place, the word "bronze" is not correct as the alloys are really brasses, and practically all bronze welding rods are composed of about 60 per cent copper and 40 per cent zinc. This copper-zinc ratio produces the best combination of high tensile strength and ductility, and has, therefore, been used in commercial practice for all alloys of this type.

Fig. 1—Photomicrograph showing the structure of alpha brass base metal. All the grains are of the same composition. The dark areas are globules of lead, added to improve the machining properties of the alloy.

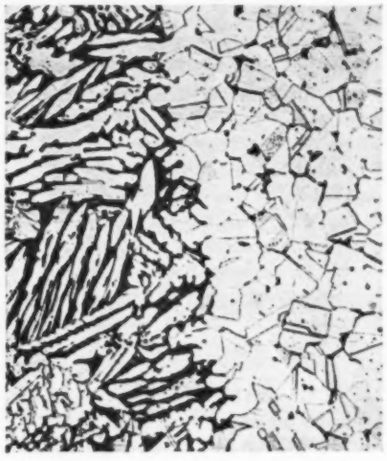


Fig. 2—Photomicrograph showing the welded joint between alpha brass base metal on the right and the alpha plus beta weld metal. This structure of the weld metal is typical of that obtained with bronze rods.

Practical Bronze Welding Rods

In spite of these excellent physical properties, the straight 60 per cent copper—40 per cent zinc alloy is almost never used for bronze welding operations. Certain characteristics are desirable in the practical bronze welding rod. The rod should tin readily when used with a suitable flux, and it should be capable of building up a deposited metal that is practically free from defects due to slag inclusions, or in the nature of blowholes. It is further desirable that during the welding operations, the fumes from zinc or other ingredients of the bronze should be kept at a minimum, since they interfere with the operator.

Several different types of filler rods are in general use. These rods contain additions of tin, iron, manganese and silicon.

The character of the bronze-base metal bond, which produces an adherence of bronze to base metal, in the case of cast iron, stronger than the base metal, has been recently investigated. It has been found that three distinct forces act to maintain adherence of the bronze to the base metal.

1. *Tinning.* A clean metal surface will receive a thin film of a molten metal of low surface tension, in the same manner that water will spread over a clean glass plate. The bond thus produced depends on the action of molecular forces at the bronze-base metal interface.

2. *Alloying.* A diffusion of the bronze constituents, copper, zinc, tin and others, into the base metal, and a corresponding diffusion of base metal constituents into the bronze takes place in a narrow zone at the bronze base metal interface. The base metal crystals at the interface, when examined under the microscope, show that there is a diffusion of the bronze constituents into the crystal grains and an alloying of the bronze metals with the base metal.

3. *Intergranular Penetration.* The action of the molten bronze on the base metal surfare opens up the crystal grain structure of the base metal surface and allows the bronze to penetrate the base metal along the grain boundaries.

The action of these forces, in particular of the alloying and intergranular penetration effects, accounts for the very great strength of the bronze-base metal bond.

Physical Properties of the Bond

The first physical property of importance is the tensile strength. When the usual copper-zinc-tin bronze rod is used for welding steel, a tensile strength of about 41,000 lb. per sq.in. on unreinforced coupons can be readily and consistently obtained. The fracture is usually through the weld metal and shows some porosity, although the general quality of the metal is good. When the manganese bronze rods are used, the strength may be somewhat greater, averaging about 46,000 lb. per sq.in., but the porosity in the metal is somewhat increased.

Further information on the value of the bronze welding method is given in the forward and backward bend tests. In both of those types of tests the results depend to a great extent on the amount of porosity in the weld metal. Good quality welds with the copper-zinc-tin alloys will have rela-

Abstracted from Section VII of the publications of the Oxyacetylene Committee, The International Acetylene Association.

Bronze Welding of Cast and Malleable Irons

tively high ductility as the metal is inherently ductile, but manganese bronze welds usually are poor in the bend test.

Adjusting the Oxyacetylene Flame

To adjust the oxyacetylene flame so as to give a slight excess of oxygen, it should be first set for the correct size of neutral flame for the particular orifice that is in use. Slightly increasing the oxygen changes the color of the flame from a slightly yellowish tinge, which is experienced with an excess of acetylene, to a harsh looking blue, and the cone is shortened so that it will not be quite so distinct as in the neutral flame.

With a suitable flux the only problem is to produce the correct temperature. Fortunately, if too high a temperature has been reached there is a characteristic rolling up of the bronze into little balls, and elimination of same by the force of the flame. If, on the other hand, a sufficiently high temperature has not been reached, the bronze will not spread out on the base metal and will not properly adhere where it has been melted from the rod and dropped onto the base metal.

Advantages of Bronze Welding

There are several advantages for bronze welding. Because of the lower temperature at which the bronze can be added to the base metal, there is an increase in speed of making the joint, and less heat from the oxyacetylene flame is required to make the joint than to make a true fusion weld. Metallurgically the bronzes have a characteristic of yielding readily as they cool until the temperature is below 500 F., and there is an appreciable yielding under reasonably low stresses even at atmospheric temperature. This yielding as a single operation does not weaken the deposited bronze metal. Therefore, locked up stresses are reduced materially in a casting that has been welded with bronze, and one of the technical difficulties of the welding operation is automatically minimized.

It is seen from the above that bronze welding should not be used where the finished work is to be subjected to temperatures above 500 F., and it has also been learned that bronze should not be used where relatively high stresses such as 15,000 lb. per sq. in. are being applied to the finished work with such rapidity as to cause fatigue of the metal. Inasmuch as iron castings are seldom subject to stresses in excess of 5,000 lb. per sq. in., this effect can never be an important one in the welding of cast iron. This same comment can be made with regard to bronze welding of malleable iron.

Preheating

Because the metal of a casting must be heated along the line of weld, which will set up stresses due to difference of temperature within the casting itself, there must be an adjustment or compensation of stresses by proper preheating. With small castings the use of the welding flame itself will be adequate for preliminary heating of the zone a few inches away from the line of weld, and probably the heat of welding will dissipate throughout the entire casting to a sufficient extent. This will apply to simple castings of 40 to 50 lb., and even to 100 lb. weight. It also applies to practically all malleable castings because they are seldom of large size.

Large iron castings and iron castings of intricate shape should, however, be given a fair amount of preheating. The heat that is added to these castings enables the welding operation to be conducted with less oxygen and acetylene than would otherwise be utilized, and is therefore an economy. It also tends to increase the speed of the bronze welding operation.

Bronze Surfacing

A welding operation that does not join two parts of metal but is only an addition to one surface, is conducted on quite an extensive scale. This is called "bronze surfacing." The method of adding the bronze to the base metal is identical with the practices described herein wherein the surface is first "tinned" and then the bronze is added.

Bronze surfacing is used in many places where it is advantageous to have the bronze carrying a load or withstanding chemical reactions of the product being handled. The friction of bronze on steel is materially less than that of steel on steel, and the bronze is particularly adapted by toughness to withstand the wear of moving parts. Where hardness is desired bronze is of course not suitable, and in those cases "hard surfacing" may be the method to be preferred. Where worn cast iron or steel parts are to be refitted bronze welding serves a very useful purpose of rebuilding the surface, which operation is followed by machining so as to give the desired dimensions.

Hand Torch Bronze Welding Data

The rate of deposition of bronze is greater for a given acetylene flow than that of cast iron, steel or other metals of high melting point. Exact data for estimating the cost of bronze welding cannot be given to include the variety of operations for which bronze welding is used. Since cast-iron repair work and bronze facing involve an irregular and changing relation of surface and volume of base metal to surface and volume of bronze to be deposited, and since the base metal, in practice, is subjected to a varying amount of preheat, the figures in the following table are necessarily approximate. Thus, a certain amount of judgment must be applied to selecting figures from the ranges quoted, depending on the size of the work, the degree of preheat, the dimensions of the weld, and the degree of heat conductivity of the base metal.

Rate of Depositing Bronze

Bronze deposited lb. per hour	*Acetylene flow cu.ft. per hour*	*Oxygen flow cu.ft. per hour*
.23 – .40	2.3	2.5
.49 – .80	4.9	5.4
.85 – 1.40	8.5	9.4
1.70 – 2.83	17.0	18.7
2.60 – 4.30	26.0	28.6
3.20 – 5.30	32.0	35.2
4.40 – 7.30	44.0	48.4
5.60 – 9.30	56.0	61.6
7.10 – 11.80	71.0	78.1
8.80 – 14.70	88.0	96.8

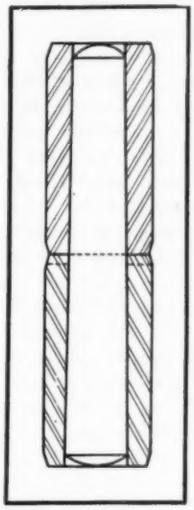
The flux consumption will vary with the nature of the base metal and with the condition of its surface. An average flux consumption of 0.025 lb. of flux per pound of bronze deposited can be reckoned with.

Ideas FROM PRACTICAL MEN

Taper Dowels?

H. R. HAGEMAN

Apparently no satisfactory solution has been found for the problem of fastening parts of machinery, tools or dies, so that they will maintain their location accurately when disassembled frequently. For example, hardened and ground and properly fitted dowels are quite satisfactory for parts which are to stay put when once assembled, but in cases where they must even occasionally be removed and replaced they are far from being satisfactory to the repair man.



Ground bushings and a ground taper pin are suggested for accurate location of parts that must be disassembled frequently

The illustration shows a method of doweling for which the following advantages are claimed: All parts are to be hardened and ground and are designed to be manufactured in quantities in various sizes to correspond with the common straight dowels now obtainable. The bushings which are straight on the outside may be fitted in the same manner as the common dowels but should be slightly tighter. The tapered pins are not nearly so likely to roughen or sieze as the straight pins invariably do in time. Should compression of either bushing tighten the upper thinner walls this condition may be corrected by pressing it through for a short distance as at *X* and grinding flush again.

As a safety measure on work such as punch and die sets where there is possibility of any pin jarring loose and dropping between the working parts, mount these pins with the large end up.

Various Holes From Single Dies

IRA S. WILLIAMS

In the radio and telephone industries, apparatus mounting tends toward the rack and panel method. Standard vertical racks known in the trade as "101 Type" are utilized for mounting ¼-in. steel apparatus panels of standard length but varying widths. These standard panel blanks must, of course, be machined to meet various requirements.

Probably the most difficult manufacturing problem relative to these panels is the machining of the larger holes of various shapes. These holes are neces-

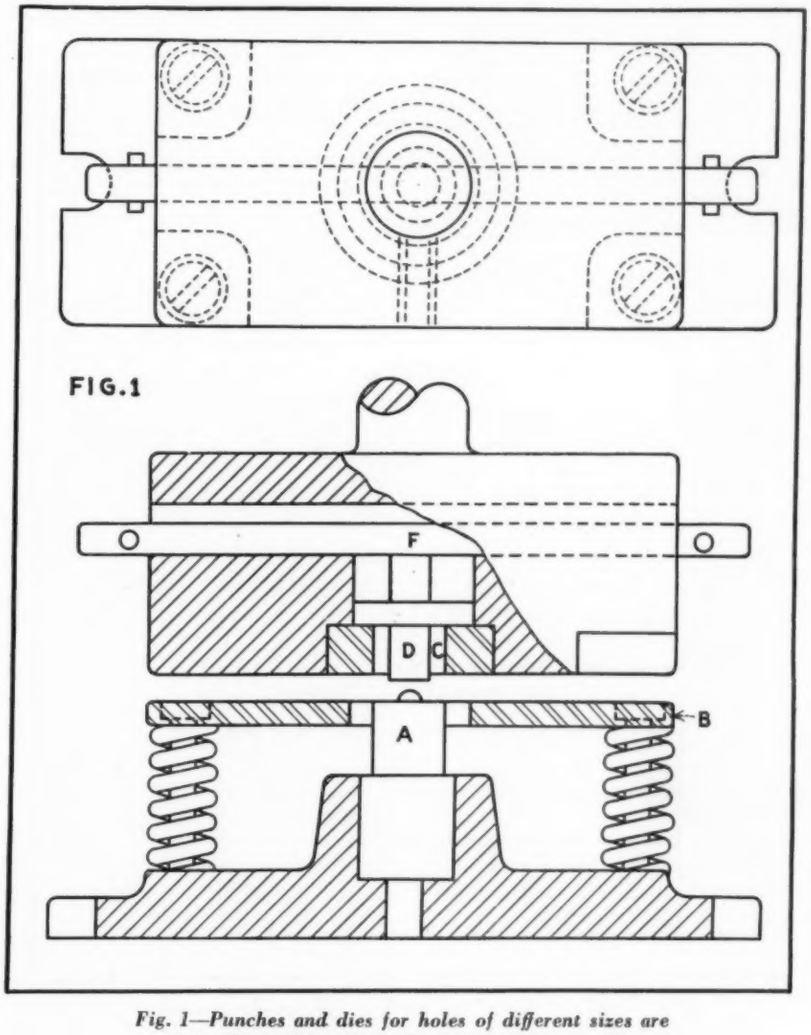
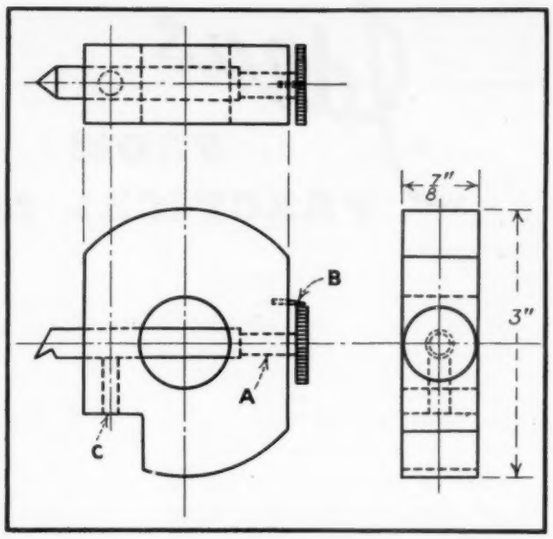


Fig. 1—Punches and dies for holes of different sizes are interchangeably mounted in this piercing die

sary because apparatus is mounted on the backs of the panels, and meter dials and manually operated devices must be accessible from the front.

The tools illustrated were devised for this purpose. Fig. 1 shows a die for piercing round holes, the punch being on the bottom for ease in handling the work. Punches and dies of suitable sizes are inserted in nests and made fast with setscrews. The panel is located by a pilot attached to the punch. Pilot holes in the panel are 9/32-in. in diameter and are drilled previously in a jig along with the small holes. Spring-actuated shedder *B* removes work from punch *A* after the hole is pierced. Punchings are removed from die *C* by knockout *D*. Bar *F* actuates the knockout on the upstroke of the ram. The ends of the bar contact stops made fast to the press frame.

A tool for shearing out various square and oblong holes is shown in Fig. 2. Registration is taken from previously drilled holes. The features of this tool are the adjustable quarter-round pilots, and the removable shear blades of various lengths. The holes for mounting shears and gages can be placed at any suitable pitch.



The cutter is adjusted by a screw of 40 pitch, the amount of adjustment being read by a pointer in connection with the graduated head of the screw

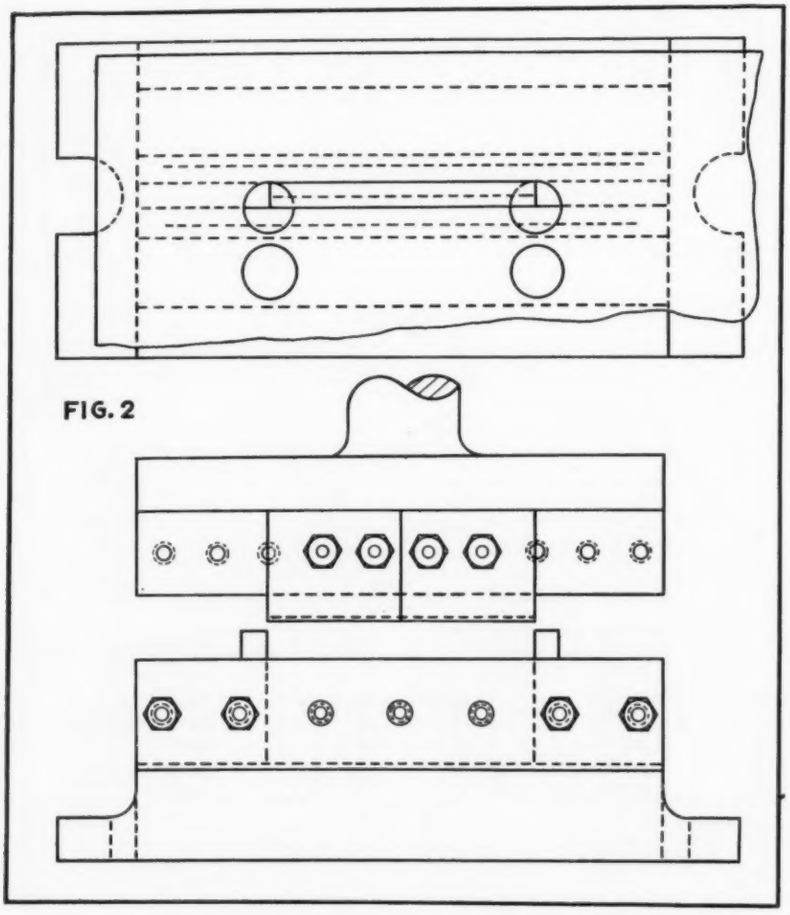


FIG. 2

Fig. 2—Shear blades of various lengths are readily mounted for shearing out either rectangular or square holes. Quarter-round pilots are adjustable

Micrometer Boring Head

LEONARD KROLL

We do a small amount of gas-engine work and we designed the very simple micrometer boring head illustrated for boring the babbitted connecting-rod bearings, the operation being performed in a small milling machine. The arbor has a clearance hole through which the cutter passes, and the head is held in place by the usual clamping nut, the arbor being unsupported at the outer end.

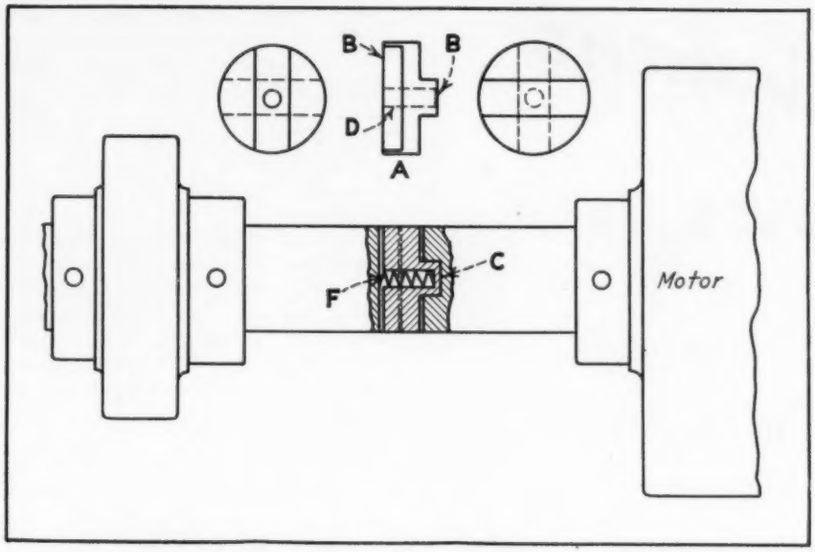
Micrometric adjustment of the cutter is obtained by the screw *A*, which has 40 threads per in. This screw has a large head graduated in 50 divisions, the graduations being read by the pointer *B*. It will thus be seen that by turning the screw one division the cutter will be moved 0.001 in. Half divisions are easily read. After adjustment has been made, the cutter is locked by a safety setscrew at *C*. While there are many types of micrometer boring heads in use, the simplicity, rigidity and inexpensiveness of this head makes it a useful adjunct for the smaller machine shop.

Modified Oldham Coupling

JOHN A. HONEGGER

In a motor gear drive assembly it was necessary to employ a coupling that would accommodate itself to any slight misalignment of the shafts, and yet not be bulky. Such a coupling member is shown at *A*. It is a disk of the same diameter as that of the shafts and has tongues *B* on both sides and at right angles to each other.

The ends of both shafts are cross slotted, as at *C*. The coupling member is placed between them, the tongues



The coupling member has tongues on both sides at right angles to each other and slidably fitting in cross slots in the ends of both shafts

engaging the slots and being a sliding fit therein. The blind hole *D* having a flat bottom is drilled to receive the spring *F*, which prevents the coupling member from rattling.

In assembling the device, with the shafts spread apart endwise, the coupling member is placed with one of its tongues in engagement with the slot in one of the shafts, and the spring is put into the blind hole. The shafts are then brought together so that the opposite tongue on the coupling member engages the slot in the other shaft. It cannot fall out of place because of the right angle position of the tongue.

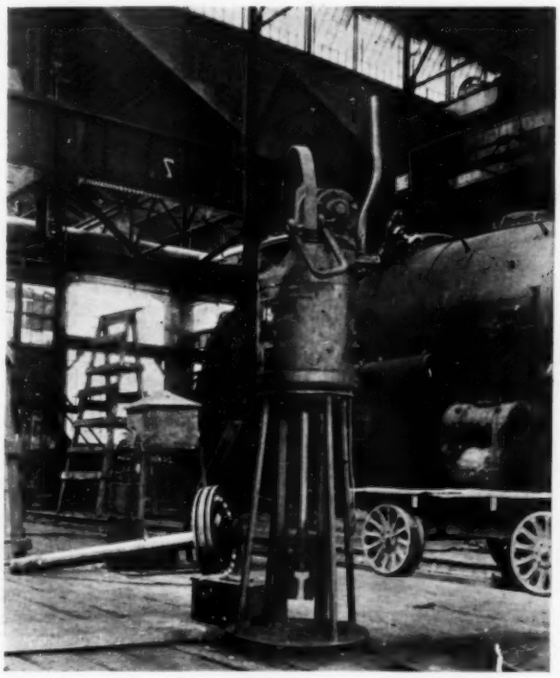
In bringing the shafts together there should be enough clearance between their ends and the coupling member to prevent any possible contraction of the base plate from binding the coupling member.

Cylinder Head Grinder

FRANK C. HUDSON

Grinding of the joint between the locomotive cylinder and its head is common practice in railroad shops. Methods differ, however, from the use of a long bar by a couple of husky laborers to the use of air to provide the power. The device shown is in the Princeton, W. Va., shops of the Virginian railway. It is simply an air cylinder mounted on a vertical frame and provided with a suitable valve for controlling the reversal of piston.

The crane picks up the whole apparatus and sets it down beside the cylinder head to be ground in. A flat bar is fastened in the opening at the lower end of the piston rod and across the cylinder head. Admitting air to the cylinder moves the piston up and down and grinds in the joint. Air is available at all necessary points and the vertical pipe is the exhaust. The device is self-contained, is easily handled and saves a lot of time.



A portable air-driven device is used to grind in cylinder heads in a West Virginia railroad shop.

Where Safety Cuts Corners

Hazard of having operators' hands or wrists squeezed between the clamping bolt heads and the punch holder for sheet metal dies is being eliminated by the Acklin Stamping Company by trimming the punch holler corners. Besides affording better light and consequently greater visibility at the point of operation, this practice decreases the weight of the die and makes it easier to handle. Not only does cutting corners in this way promote safety but also actually lowers operating costs.

Corners are cut off the punch holder to promote safety and to lower operating costs

It is impractical to cut off these corners until the die has been made as many times the full face of the punch holder is required in completing the die under construction. The Acklin plan is to try the die after completion and cut off with a saw or burn off with a torch any protruding corners beyond the ram and working steels. If burning is used, particular care is exercised to keep the flame a safe distance from the cutting or forming edges to eliminate any possibility of annealing the working surface.

Operators like the idea so much that they are taking the lead in pointing out to their foremen all the punch holders that can be trimmed.

Shop Equipment NEWS

Cincinnati Surface Broaching Machines for Engine Blocks

There were recently exhibited at the plant of the Cincinnati Milling Machine Company, Cincinnati, Ohio, two surface broaching machines which are larger than any heretofore built for production. They were built to order for an automobile manufacturer and have since been installed.

One of these machines performs the operation of broaching the pan rail or bottom face and the bearing cap seats on a cylinder block. This particular manufacturer has a 6-cylinder and an 8-cylinder engine to manufacture, and the cylinder blocks are identical with the exception of length and number of cylinders. The broaching machine is equipped with a fixture which will accommodate either block without the necessity for any change or any attention on the part of the operator.

The second machine broaches the top or cylinder-head surface on the same two cylinder blocks. Here again no change-over is necessary as the fixture will accommodate either block, whichever comes down the conveyor line. The production obtainable per machine is between 50 and 55 cylinder blocks per hour and one operator can easily operate the two equipments.

As a result of extensive experiments performed by the supplier of the machines, the inserted-blade broaching tools have been carefully designed to permit the removal of approximately $\frac{3}{16}$ in. of metal in the minimum amount of time and still produce the finished work piece to tolerances for accuracy and flatness of surface and to a degree of finish not heretofore realized.

As may be observed, the machines

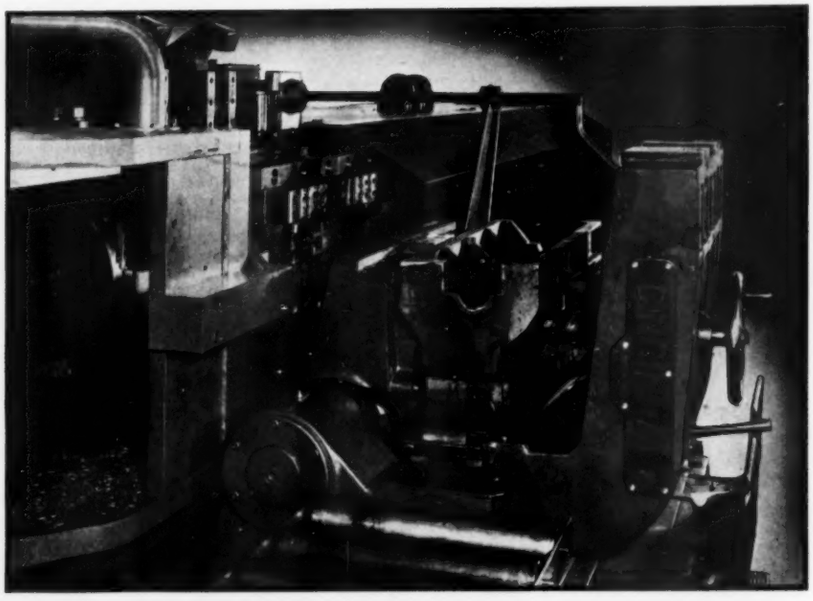


Fig. 2—After the fixture is loaded it is swiveled 90 deg. to present the pan rail and bearing cap seats to the broach which lies vertical

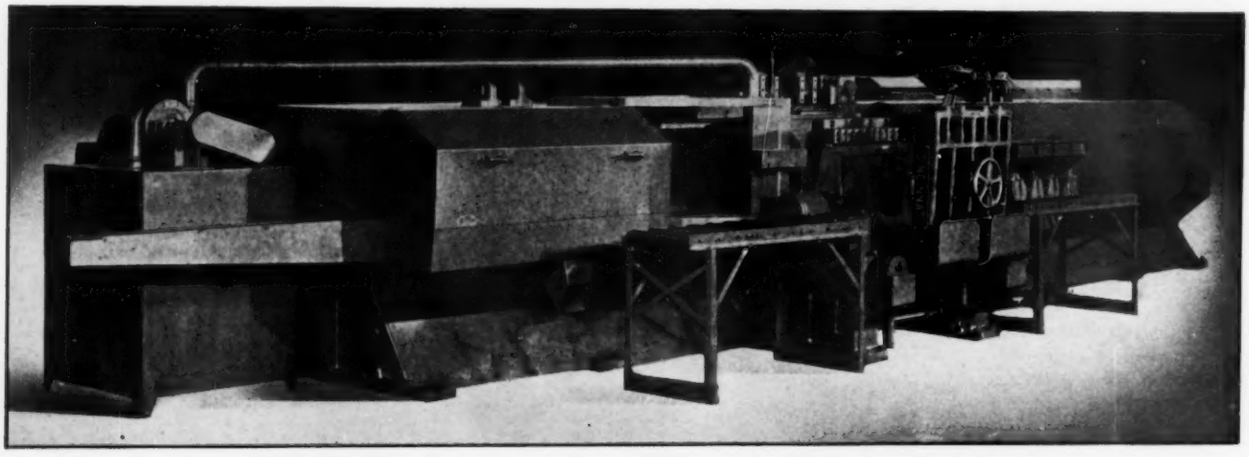


Fig. 1—Pan rail and bearing cap seats of 6- and 8-cylinder blocks are taken in a single fixture

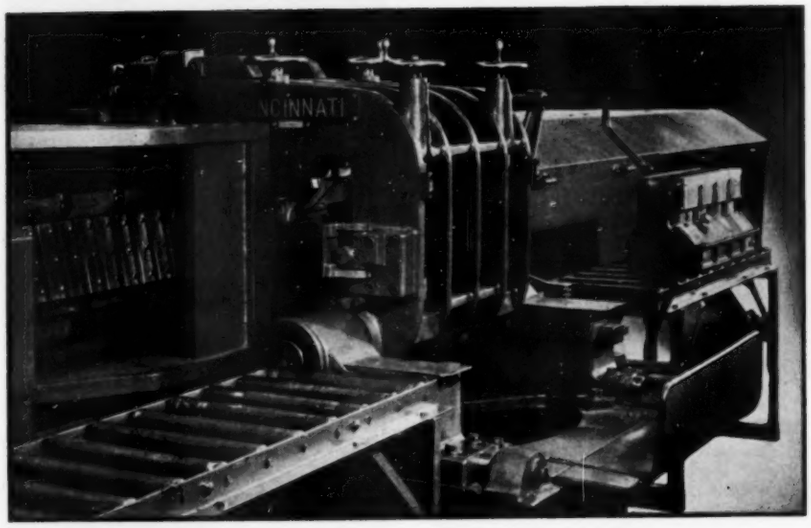


Fig. 3—Broaching the top surface of the block is done in this set-up. The fixture is shown swiveled to the cutting position

are horizontal stroke machines, the broach rams moving horizontally. The plane of the broaching tools, however, is vertical. As may be seen from Fig. 2, showing a close-up of the fixture and of the tools for the operation of broaching the pan rail and the bearing cap seats, the cylinder block is moved down the conveyor line into the fixture. It is located against five foundry locating spots and is clamped.

At the completion of the locating and clamping, the operator throws a lever to operate the hydraulic mechanism which swivels the work-holding fixture through 90 deg., bringing the work into the broaching position. At the completion of the broaching stroke the fixture is returned to its original position and the operator utilizes the time for the return of the ram to slide the finished piece out of the fixture and a new piece into position.

Fig. 3 shows the equipment for the second operation, that of broaching the top surface. It shows the fixture in the cutting position. A feature of these installations is the use of tungsten-carbide finishing tools.

Westinghouse A.C. Welding Torch

An a.c. welding torch has been developed by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., for use with its 100-, 125- and 250-amp. alternating current welder. Some of the more common applications of the a.c. welding torch include: sheet steel, sheet aluminum, sheet and extruded brass and bronze, stainless steel, manganese steel, silicon iron, copper base alloys, and non-ferrous castings.

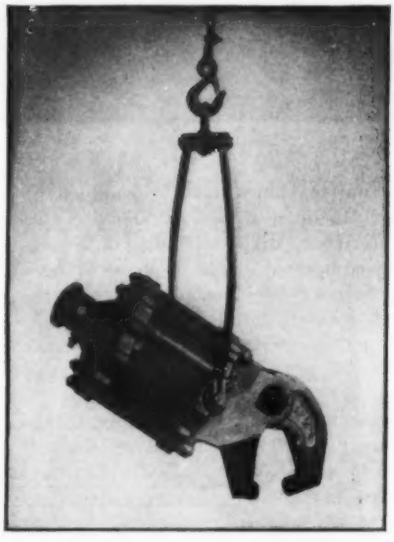
The a.c. welding torch is used much in the same manner as the acetylene torch. The arc flame is the source of heat for fusing the parent and filler metals. Where filler metal is required, it is applied externally to the flame and puddled into the pool of molten metal until the proper fusion is obtained. In most cases a flux is required.

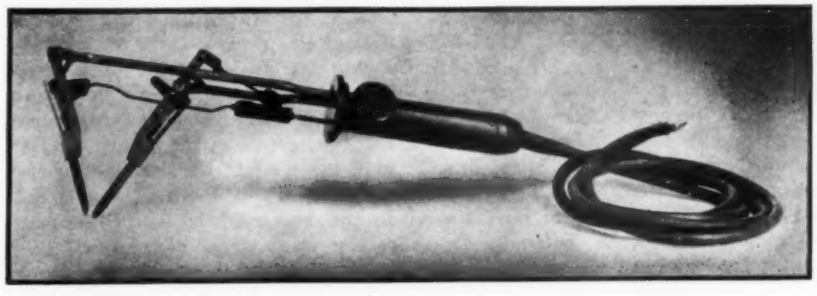
Alloys containing zinc have presented certain welding problems. They cannot be welded by the metallic arc process, but by following the proper procedure, good welds can be made on these alloys when using the a.c. welding torch.

With the a.c. arc welding torch, the high-frequency alternating current from the welder is utilized to form a smooth and stable flame for welding and brazing. The electric flame thus produced does not have the usual large outside envelope. It is an individual flame, conical in shape with a blunt tip permitting an even distribution of heat. It lacks the usual arc blow and driving force common to other flames and thus permits the welding or brazing of extremely light gage sheets and small castings with control of metal flow. The arc formed between the carbon electrode tips burns carbon gas derived from the carbon rods, thus producing a flame practically free from oxygen.

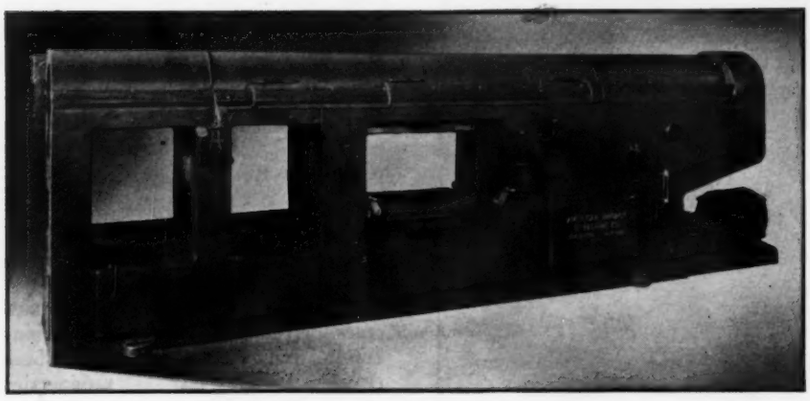
Hanna 10-Ton Portable Riveter

A light, compact alligator or nutcracker type portable riveter weighing 100 lb., and rated at 10 tons, has been developed by Hanna Engineering Works, 1765 Elston Ave., Chicago, making use of the latest advances in light steel alloy heat-treated castings. The mechanism is entirely inclosed. A hardened and ground alloy steel wedge attached to the aluminum piston unit transmits the power to a hardened and ground roller mounted in roller bearings in the moving jaw. This jaw closes on the rivet with a uniform, predetermined pressure even when the variation in length of rivet and grip is as much as ¼ in. It will drive ¼ in. rivets cold, and ⅜ in. hot.





American Broaching Machines



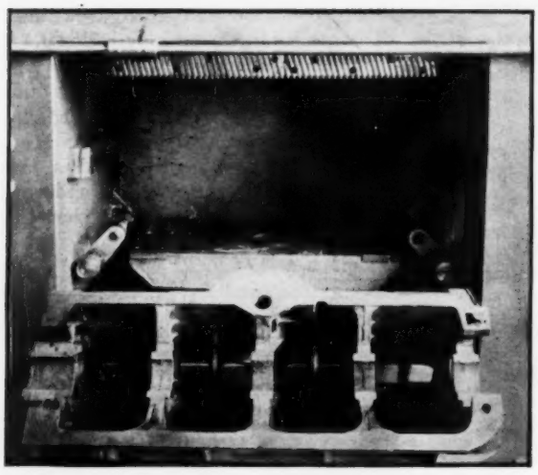


Fig. 1 — Lock seats for crankshaft bearing caps in cylinder blocks are surface broached on this American horizontal machine

Fig. 2—Close-up of the fixture and operating table, with a cylinder block in the foreground

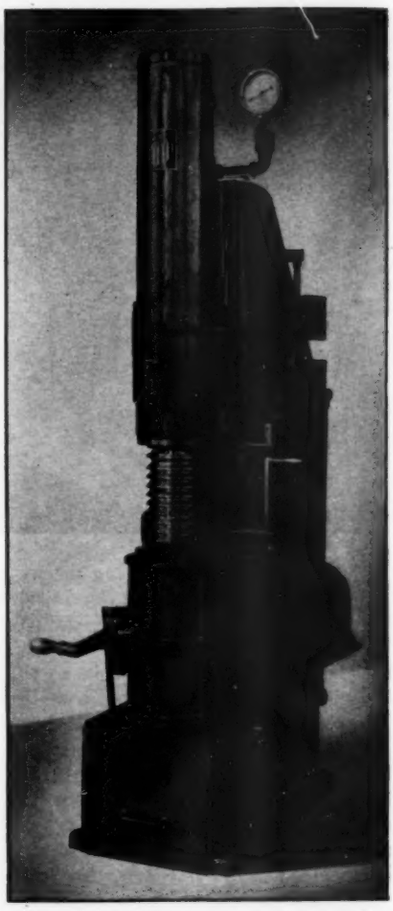


Fig. 3 —A slide way causes the broach to travel downward in a straight line with reference to a clearance groove in the work-piece

Four machines have been added by the American Broach & Machine Co., Ann Arbor, Mich., to its line of broaching equipment. Fig. 1 shows a horizontal model for surface broaching the lock seats for crankshaft bearing caps in cylinder blocks. The hydraulic cylinder is integral with the sliding member to provide support for the broach. This construction permits the placing of the slides above the cut where they are free from dust and chips and results in accurate alignment.

The fixture in this machine is carried on a table or elevator which is actuated hydraulically by the same unit that provides power for the broaching slide. In its lower position the fixture is at a height suitable to receive the cylinder blocks arriving from the shop conveyor system. The operator moves a cylinder block into position, then shifts a lever which causes hydraulic pressure to raise the block and clamp it automatically against hardened rest plates and dowel pins. A second lever, interlocked with the clamping, then starts the automatic cycle of the machine. The broaches approach the work rapidly, then slow down for broaching, after which the work is released and the fixture lowered so that the operator can change work pieces while the broaches are returning to the starting position.

A 15-ton vertical machine is shown in Fig. 3. It was built for finishing the bore in type metal printing cylinders or mats to a diameter of approximately 6 in. The ram of this press has a slide-way which causes the broach to travel downward in a straight line accurately in reference to a clearance groove in the work piece. Otherwise the machine is similar to other American Broaching Machines. The last section of the broach for this work has a slight burnishing action so that the cutting teeth of the broach do not drag over the finished surfaces on the return stroke of the ram.

A close-up of the machine is shown

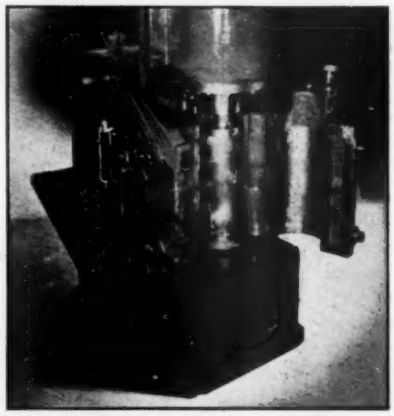


Fig. 4—The front half of the fixture is hinged on one side while the other has a double cam lock

in Fig. 4, illustrating the work-holding fixture in the open position and with the broaching tools removed. The front half of the fixture is hinged on one side, while the other has a powerful quick-acting double-cam lock. At

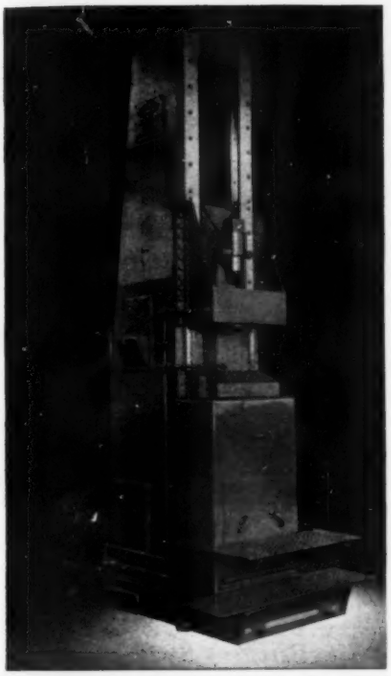


Fig. 5—Two or more broaches can be mounted on the Model V-58 semi-automatic vertical broaching machine

the top of the front half of the fixture is an adjustable block for retaining mats of different lengths during the broaching operation.

Fig. 5 shows a Model V-58 semi-automatic broaching machine with a normal working capacity of 50 tons and maximum capacity of 56 tons. This machine is supplied for pulling broaches upward although it can be arranged to pull them downward if the working conditions indicate that this would be desirable. The column is built in one piece and has adjustable hardened and ground wear plates and gibs.

In this machine the broach is raised automatically, connected to the pulling head and returned to the starting position after broaching is completed and then released. As soon as broaching is completed the work-piece drops into an angular chute and is discharged at the right-hand side of the machine. Additional output can be secured by arranging the machine to pull two or more broaches at one time. Each broach can operate on the same type of work pieces or different types. Specifications for the Model V-58: height, 14½ ft.; floor space required, 4½ x 8 ft.; maximum length of broach used, 68 in.; largest diameter of work the machine will receive, 13 in.; maximum cutting speed, 18 ft. per min.; return speed, 24 ft. per min.

Heald No. 73 Centerless Cylinder Grinder

For grinding the bores in large sleeves, aircraft-engine cylinder sleeves for example, the Heald Machine Co., Worcester, Mass., is offering the No. 73 centerless cylinder grinder. It is said that this machine will produce to exceptionally close tolerances, together with the best possible concentricity. It is identical with the air-

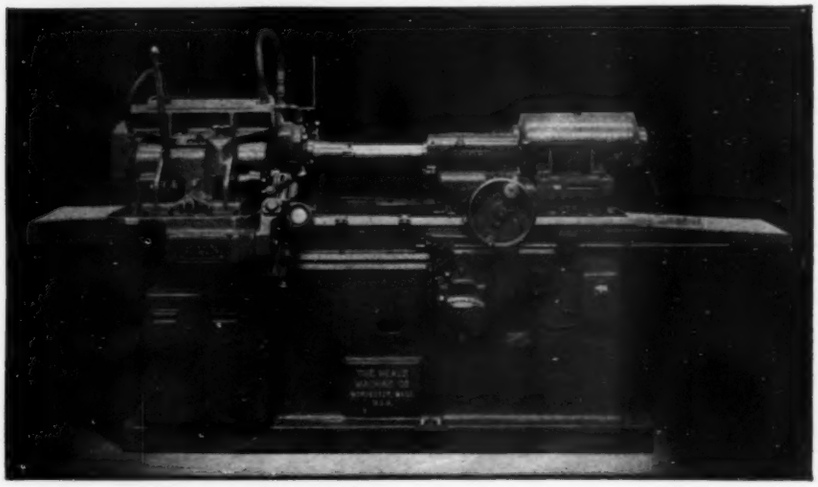


Fig. 1—Heald No. 73 centerless internal grinder for grinding large sleeves from 4 to 8 in. O.D. and up to 16 in. long

plane cylinder grinder, with the exception that a centerless unit replaces the former conventional workhead.

The No. 73 centerless is usually furnished as a plain machine with a direct-reading dial indicator. In view of the size of sleeve which this machine is designed to grind, it was felt that the expense of incorporating an automatic loading and unloading device was unwarranted. The manual device is both simple in handling and effective in operation. The close-up of the centerless unit, Fig. 2, shows the large roll on the left which is the regulating roll. This roll serves to guide the work. The supporting roll is mounted on precision bearings in one end of a bracket attached at the other end to the main pressure-support-roll mechanism base. The supporting roll and its bracket are adjustable and can be set to accommodate sleeves of varying outside diameters. The pressure roll is also mounted on precision bearings in one end of a bracket which in turn is mounted on ball bearings at its other end. The pressure roll can thus be swung about its pivot by means of a hand lever and toggle arrangement. Correct work surface speed is always obtained because the surface of the work bears a constant relation to the surface speed of the driving roll.

The indicator device registers readings by means of contact with the work by a diamond pointed finger. This finger can be withdrawn entirely from the machine while loading.

Fig 2—The close up of the centerless unit shows the regulating roll at the left, the supporting roll at the bottom and the pressure roll is shown at the upper right

Barrett Pallet Type Lift Truck

A hand-operated lift truck to handle low 3½-in. pallets of tinplate, strip steel and other products, has been built by Barrett-Cravens Co., 3255 West 30th St., Chicago. It is made in capacities of 2,500 and 3,500 lbs. The

carrying frame is 15 in. wide overall, with a 5-in. space between the two forks. A low 3½-in. frame height permits handling skids or pallets with a 4-in. clearance.

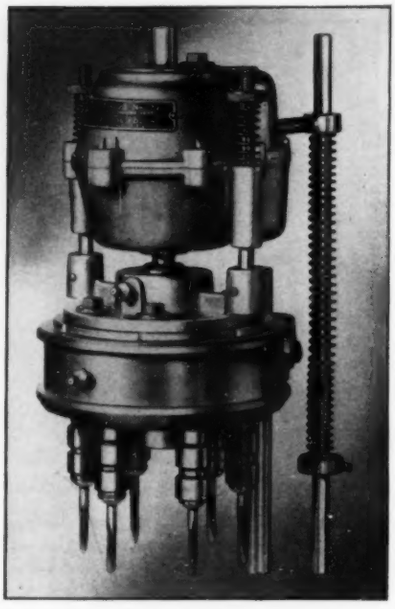
Dual wheels in the rear are full compensating for rough floors and are ball bearing equipped. The 7-in. diameter front wheels work on a large kingbolt set on a low, large turntable. The 2¼-in. lift is accomplished with one stroke of the handle. Other features include an adjustable lifting mechanism, widespread front wheels, spring handle hold-up and a vertical oil release check.

Ettco-Emrick Tapping Heads

Multiple - spindle tapping heads, which can be made up to order from stock parts, are being placed on the market by the Ettco Tool Co., 594 Johnson Ave., Brooklyn, N. Y. With this system of furnishing multiple tapping heads to suit the customer's requirements a stock case is bored to suit specifications and the stock gears and other parts assembled within the case and quickly made ready for shipment. A friction driven tapper combined with a faceplate to which the gear-case is interchangeably bolted, is furnished with this equipment.

A ball bearing face plate, with Morse shank, can be furnished for using gear cases for drilling. Work can be first drilled and then tapped by changing face plates, but using the same gear case.

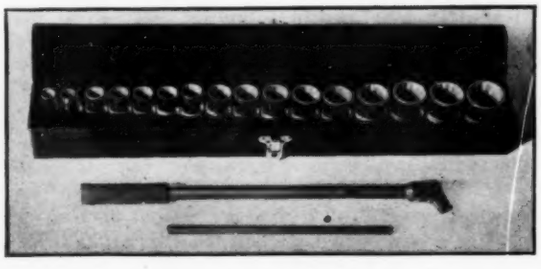
The shortest center-to-center distance of the spindles for which stock gears are available is ¾ inch and the shortest possible center distance is 9/16 inch, any



spacing under ¾ inch being furnished to order.

The standard faceplate driving unit is made in four sizes. The smallest size with the case geared 1 to 1 has a capacity for driving two No. 8 or four No. 3 taps in soft metal.

When the case is geared in a ratio of 2 to 1 the capacity is two No. 10 or four No. 6 taps. The largest size has a capacity for driving three 5/16 or six ¼ in. taps with the case geared in a ratio of 1 to 1. With a gear ratio of 2 to 1 the capacity of the largest size is three ⅜ in. taps.



Goggles have been removed and the tray has lifted, affording a better view of the "Micro Switch" installation

Burgess Switch as Grinder Safety Device

C. F. Burgess Laboratories, Inc., Freeport, Ill., has enforced the use of goggles in its plant by a device fitted to the grinding machines in the shop. This device consists of a goggle tray or holder on which the goggles are placed when not in use. One end of the tray rests upon an actuating plunger of a sensitive electric switch known as the Burgess "Micro Switch" and connected in the grinder motor circuit. So long as the goggles remain in the tray their weight is sufficient to maintain the switch in an open position so that the grinder motor will not start. When the operator removes the goggles the switch snaps closed.

Bonney D3 Socket Set

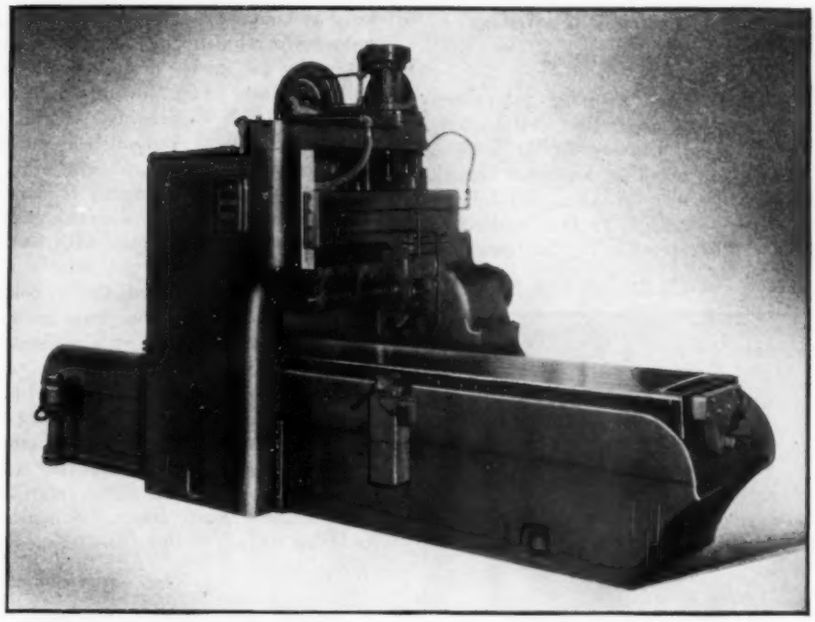
A set of sixteen sockets with double hexagon openings ranging from 7/16 to 1¼ in. for ½-in. square drive, is being marketed by Bonney Forge & Tool Works, Allentown, Pa. A 15-in. hinged handle with cross handle is supplied as a part of the D3 set.

Made of Bonney "CV" chrome-vanadium steel, each socket can withstand the most severe use. Each piece is chrome-plated and polished. The set is packed in a metal case measuring 20½ x 3¾ x 2 in. Net weight, 8½ lb.

Sundstrand Hydraulic Rigidmil

The Sunstrand Machine Tool Co., Rockford, Ill., has developed a rigidmil having an automatic hydraulic operating cycle which includes actuation of the spindle-head and clamping both ends of the cross rail as well as hydraulic feed and rapid traverse of 72 in. in both directions of the table. The machine shown is for milling five intermittent keyways in eight heavy shafts simultaneously. Depth of cut is held within 0.002 in.

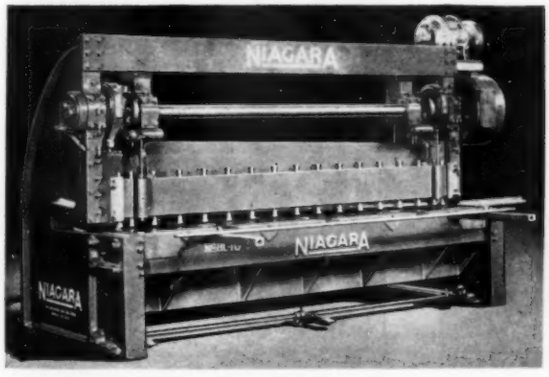
The operating cycle of the machine is entirely automatic after starting, and is accurately controlled by easily adjusted dogs—a feature which makes the machine readily applicable to a wide variety of work in addition to that for which it was sold. The spindle head rapidly approaches the work, feeds to depth against an easily-adjusted positive stop, and clamps hydraulically. The table feeds to a predetermined distance; then the head unlocks, rises, table advances to position for next cut and cycle is repeated until all keyways are complete. Then the table rapidly traverses to starting position and stops. Circuit is equally effective in both directions and entirely suitable for "climb cut" milling. This machine provides one of the most complete examples of the successful application of hydraulic pressure to machine tool actuation.



Niagara HL Power Squaring Shears

Series HL power squaring shears, designed for high production, accurate flat strip cutting has been announced by Niagara Machine & Tool Works, Buffalo. A heavy steel plate structural member is bolted and doweled to the top of the housings to counteract the upward thrust of the center bearings and the direct thrust from the holddown mechanism. This member ties the entire machine together at the upper end. The patented triangular box section steel crosshead, with rearwardly sloping front web, permits a large opening between the holddown bar and the crosshead, giving perfect vision to the cutting line of the machine. This opening, combined with the fact that the top of the holddown bar is low, enables an operator to view the cut when shearing to a line.

The bed is a massive one-piece high tensile iron casting with three hand holes and four T slots for the convenience of the operator and with pockets so that knife bolts are accessible from the top of the bed. The broad deep flat surfaces at the ends of the bed have heavy keyways in the center which engage broad keys resting in the housings. The bed is adjustable front to back, being guided by these keys which make it impossible for the bed to lift off its seat when the shear is cutting. The holddown is toggle operated and has independent feet exerting increased pressure close to the knife edge, facilitating accurate cutting of flat narrow strips. It is driven by a train of generated spur gears, enclosed in a bath of oil. All gears and the outer end of the main eccentric shaft run on anti-friction bearings.



Main members of the machine are so placed that there is unobstructed vision from the front of the machine to the back

Gerstner 26-in. Tool Chest

A tool chest, made 26 in. long to accommodate the 24-in. scale used by patternmakers, machinists and toolmakers, has been developed by Gerstner Tool Chests, 157 Columbia St., Dayton, Ohio. It has ten drawers of assorted sizes, and an upright drawer compartment to take the *American Machinist* Hand Book, or a drill block. The front lid of the chest slides on steel bearings under the bottom drawers, swings up and locks automatically when the top lid is closed. Finish is either art leather or polished quartered oak. Nickel-plated fittings, a steel-cored leather handle, and felt-lined drawer bottoms make this sturdy and handsome.

Ettco-Emrick Tapping Attachment

A high-speed tapping attachment with a sensitive friction clutch drive, regulated by pressure on the lever of the drilling machine, has been brought out by the Ettco Tool Co., 594 Johnson Ave., Brooklyn, N. Y. It is so designed that if the tap sticks or "bottoms," the

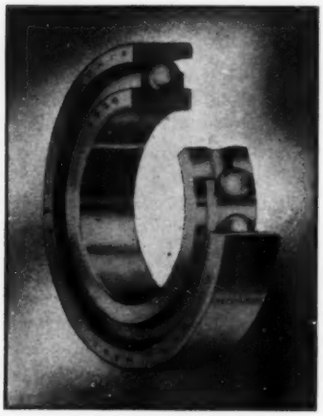
clutch will slip. The automatic reverse speed is 1¾ times the tapping speed. The tap idles in the right-hand direction while being advanced to the work and turns in the tapping direction when it contacts with the work.

Main spindles have ball bearings and needle bearings are used in the idler gears. All gears are helical. The clutch has three segments of leather driving a cast iron cone. This attachment is made in two sizes for taps from ⅛ to ½ in.

Anaconda Flexible Industrial Cable

Flexibility and durability are characteristics of "Powerduct" cable announced by Anaconda Wire & Cable Co., 25 Broadway, New York, particularly to connect equipment which may have to be relocated. It resists deterioration by oil, grease and gasoline and will withstand abuse, including impact without chafing or fraying. Having a smooth exterior, it does not collect dust and presents a very neat appearance when suspended in the open. It can be firmly attached to branch-service boxes and machine-control boxes with available fittings.

Three rubber-insulated, 600 v. color-coded conductors and one bare ground conductor are cabled with saturated jute fillers, bound together by pre-saturated tape. Over this assembly is a heavy protective coat of long-fiber cotton woven like a fire hose. The outer covering is saturated and finished with moisture resisting and flame retarding compounds. Each conductor consists of seven strands of tinned soft-annealed wire.



Fafnir Compact Ball Bearings

A new series of ball bearings from 20 to 260 mm. bore size and known as 9500 series, designed for machine tool applications where unusual compactness is required with precision standards, has been introduced by Fafnir Bearing Co., New Britain, Conn. Compared with standard SAE 200 series, the bearings have considerably smaller outside diameters for the same bore dimensions. The 30-mm. bore bearing, for example, has an outside diameter of 52 mm., in contrast to 62 mm. outside diameter, in the SAE 200 series. In the larger sizes compactness is more pronounced. The reduced diameter corresponds to one of the standard metric sizes for bearings of smaller bore.

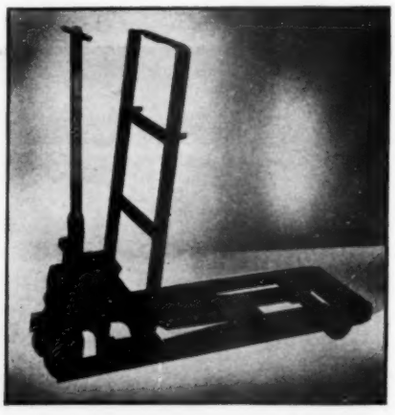
The new series provides "standard" ball bearings for applications formerly requiring bearings of special design, and opens new possibilities for anti-friction mounting of closely spaced spindles on high speed grinders and boring machines. Because of the enlarged bores which accompany standard outside diameters, large centers, adapters and arbors can be used to increase spindle rigidity without an increase in overall dimensions.

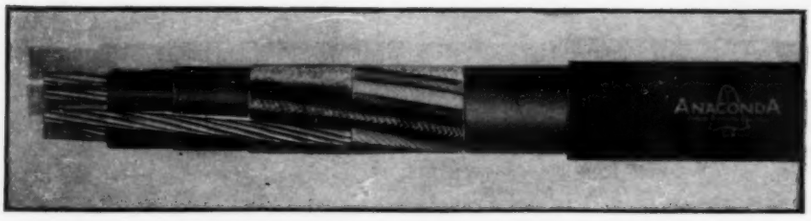
The bearings are of the "super-precision" type, in which all tolerances are held within particularly narrow limits. Width of the bearings has been mantained sufficient to provide ample supporting surface, within the housing and on the shaft, avoiding the limitations of the Narrow Width Series. Load capacities are exceptionally high for bearings of these dimensions. The 9500 Series is available in bore sizes ranging from 20 to 260 mm.

Yale Hinged Frame Truck

A double-duty, hinged, frame hand truck, built by Yale & Towne Mfg. Co., Philadelphia, handles skid platforms of varying underclearance. When the frame is upright, the truck may be rolled under platforms having clearance of 7½ in. A few quick strokes on the handle raises the load 3 in. from the floor. Where platforms with clearance ranging from 8 to 10 in. are to be moved, the hinged frame is dropped into place on the regular frame and quickly elevated.

The company also builds the multi-stroke truck without the hinged frame and provided with a lift of 5 or 6 in.





The Round Table

COVERING UP

"What ails that 3G pump out on the floor, Al? It looks as though it had rough treatment."

"That's the trouble, all right, Ed. Somebody either thought it didn't need oil or else forgot it. The bearings got dry and seized—and you know what that means."

"Pure carelessness, Al, but it makes work for us. It's going to cost real money to fix that baby up."

"Right you are, Ed. It's going to cost money—that's what's worrying me."

"Why worry? It isn't our funeral."

"I'm not so sure, Ed. It's one of those funny cases that ought not to happen. But we might have to swallow the cost."

"There can't be any question about that, Al. It surely wasn't our fault. I don't get you."

"You know how hard we worked to sell that pump to the Big Bend Paper Company. The engineer didn't want it; he wanted another make. But we finally landed the order."

"Didn't the pump make good? That is, before the bearings ran dry."

"Sure it did, Ed. The engineer admits it, but the manager doesn't know that. I'm pretty sure the engineer won't admit the pump ran dry to his boss."

"What of it? Haven't we got the evidence?"

"Sure we have, Ed. But can we haul the mill manager down here to see it? Would we know what the trouble was if we did?"

"I get it. The engineer wants to shift the blame on us. Well, don't let him get away with that."

"I know we shouldn't, Ed, but here's the point. Big Bend need several more pumps. If we assume responsibility for this failure, even though it isn't our fault, we get the order for the rest. If we don't and try to pin this on the engineer where it belongs, he's going to do his darndest to block our order."

"I'd tell him to go jump in the lake. It's blackmail, Al. Trying to save his hide at our expense. I'd—"

"I'm not sure you would, Ed. I feel the same way about it, but won't the manager be a lot more likely to believe his own man than us?"

"But we've got the evidence, Al."

"I know it. But we may not be able to use it."

"I'd lose the order first, Al."

"That's what I've said lots of times, Ed. But I know of several concerns a lot bigger than we are that fall for the same sort of blackmail."

Is it good business to cover up for a man who may decide future orders? Or is Ed right in standing by his guns?

DISCUSSION

Tools for Every Job

More than 50 years ago, I knew the proprietor of a shop who provided tools for every job to the *n*th degree. His product was volumetric gas governors. The parts were small, made of bronze and had to be very accurate. All the work was done on a battery of four turret lathes, and for each lathe he made four extra, interchangeable turrets.

The accuracy of the work was such that it took considerable time to tool up for each operation. Since multiple stops, one for each turret position, were not in use at that time, the tools had to be very accurately set in relation to one another.

At the start, when operations had been completed on one piece, the turret for that piece was taken from the machine and laid on a shelf with all the tools intact. Then one of the extra turrets was put on the machine and tooled up for the next piece, and so on for each of the four machines.

Finally, all the extra turrets were full of tools, none of which were disturbed until they needed grinding, and they made many thousand pieces between grinds. When a new run was started, all that was necessary in changing from one piece to another

was to take off the turret containing the tools for the piece just finished and to put on one that was tooled up for the next piece, and adjust the stop for the turret slide.

—MATTHEW HARRIS.

Ed's suggestion of having a set of tools for every job will work nicely under the right conditions. Where large quantities of standard parts are to be made, for which few tools can be used in common, or where production is almost continuous, it can be used to advantage. In the ordinary small shop or manufacturing plant where tools are common to a thousand or more parts, segregated tools are not practical.

In plants like Al's, the best way is to provide routing sheets showing all the tools to be used on the job. All drawings going into the shop should first be checked by the tool supervisor to make sure that all the tools are at hand before any of the machines are set up for any of the operations. In this way, the investment for tools can be kept at a minimum. Experience will show that the parts can be completed just as quickly by studying the details of construction and providing all the tools before the parts are started in production, as they can be by segregating the tools. Finding the job without tools for succeeding operations when the first operations are nearly finished is a costly set back to production.

—W. A. WALTER,
Purchasing Agent,
Pneumatic Scale Corporation, Ltd.

Al brings up the argument that it would require a greater investment if the tools for every job were segregated, but I wonder if he is correct. In the course of a year, the tool expense would be no more by segregating the tools for every job than it would be otherwise. I base this assumption on the fact that a tool can be sharpened only so many times during its life, no matter whether it is kept in a separate group and sharpened occasionally or sharpened a dozen times a day. By making a larger initial investment at the time tool segregation is adopted, the investment for tools during the following months will be less because of this fact.

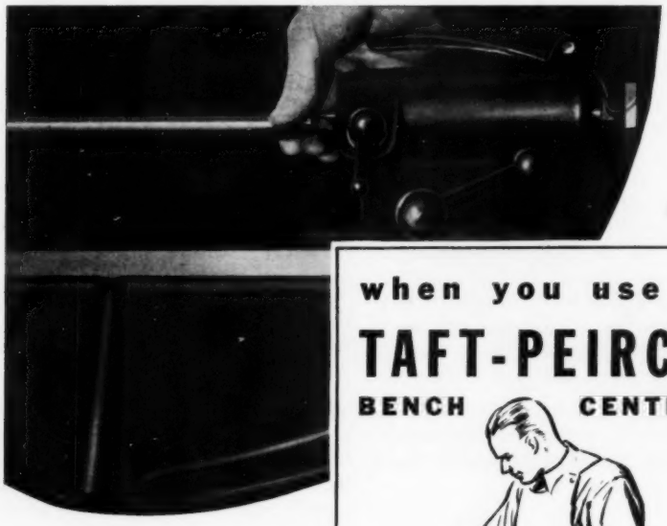
—ROGER C. DICKEY,
The International Paper Box Machine Company

As Ed claims, the plan for keeping all the tools for a particular job in one box does eliminate the work of hunting all through the tool crib to collect the necessary tools for that job, which is of a decided advantage. At the same time, the duplication of standard tools for a great many different jobs is extravagant, as it requires a tool inventory that is greater than necessary for the volume of production. That is a real disadvantage, as Al pointed out.

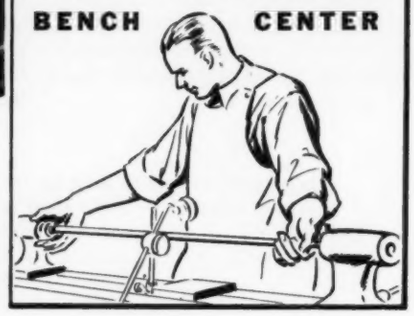
However, the plan need not be wholly rejected because of the disadvantages nor adopted in whole on account of its advantages. By a simple change the disadvantages can be eliminated, preserving all the good features of the plan.

A box can be provided for each job, as Ed suggests, but only special tools for that particular job should be stored in the box. In the box, or tacked on the outside, should be a list of the standard tools required, and space in the box should be provided for them. When the box is called for at the toolcrib, the attendant has only to add the

This Lever LENDS A HAND



when you use a
TAFT-PEIRCE
BENCH CENTER



No longer do you need three hands to do an indicating job. You depress the lever that withdraws the spring center—*with the same hand that holds the work.*

This improvement in bench center designs saves time and temper, facilitates accuracy, diminishes the danger of dropping and damaging work. For safety on heavy jobs, the spring center may be locked in position.

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WOONSOCKET RHODE ISLAND

standard tools, which are usually easily accessible.

This system has the advantages appreciated by Ed without the drawbacks suggested by Al.

—C. A. JOHNSON.

I agree with Ed that it is good management to have a set of tools kept apart for the majority of jobs or parts. Every job or part should have a tool card controlled in the tool engineering department with duplicates in the toolcribs. All special tools for a given job should be segregated, but the standard tools, such as drills, reamers, taps, etc., should be used universally. If there is anything special about the standard tools, such as grinding for different materials, they should be classed as special and kept for the particular job.

All tools necessary for the part or job should be listed on the tool cards, and any changes of design should be noted on them. While this method may increase the tool cost temporarily, the increased cost will be made up in time saved, in set-up and in supervision.

In screw machine work, it is practicable to double up on cams, but care should be taken not to have too many parts using the same cams, as it is likely to hold up production and keep machines standing idle, which is more costly than a set of cams.

The proper method depends upon the kind of product being made, but in most cases it is economical to segregate all tools for a given job.

—J. N. HOFFMAN,
Engineering Standards Supervisor, Underwood-Elliott-Fisher Company.

While not advocating tools for every job, a complete set of drills within the machines' capacity would save much time on the drilling machines.

It is up to the production engineer to see that the flow of work through the shop follows certain specified channels, and that certain jobs are always done on specified machines. It obviously follows that these machines are fully equipped with the necessary tools to cover the operations to be done. Yet, as many of the jobs can be done with the same tooling equipment, tools kept apart for every job are not necessary.

—R. G. HEWITT,
Huddersfield, Yorkshire, England.

A Step Down

Having made Jimmy foreman, Al should not have demoted him. If Jimmy seemed to be trying to do a good job, Al should have diagnosed his weaknesses, told him what they were, how to cure them, and backed him up in his work in every way. Al owed this to himself as much as to Jimmy, because his judgment, too, was on public trial. Having forced Jimmy to be foreman in name, Al should have gone to all lengths to make a foreman out of him.

Al has made both himself and Jimmy look like fools. By shifting a man about like a skittle, he has shaken the whole shop's confidence in himself. If Jimmy has any spirit, he will have gone by now. The next thing to do is to fire Al after him.

—U. S. GRANT,
Rothwell Haig, Leeds, England.

Such a blow in the eye as demotion from foremanship has been my fate several times. During young manhood I was extremely and unreasonably ambitious for position. By some

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ability, but above all, through push, I attained it, but I proved to be a failure for one reason or another. Not, perhaps, through lack of technical ability so much as through lack of natural or tempermental characteristics.

In nearly every case of demotion I requested to be employed as a journeyman, as being less humiliating than total dismissal. The crushed feeling and the unpopularity with the men soon wore off. Freedom from worry and responsibility quickly caused me to rejoice rather than to mourn. Slackness in my work or bitterness toward my successor did not actuate me, a living wage being more vital than anything else. Thus I carried on until, in course of time, craving for position again overtook me and another job as foreman was secured elsewhere.

Too elderly now for supervision and its worries, I work very contentedly and acceptably as a fitter and erector, and can afford to look back upon my foolish ambition of bygone years. However, I can sympathize with all who now carry the burden of foremanship, and I feel that those who have proved to be failures deserve every consideration and kindness that can be extended to them.

—Wm. Bryce,
Brightside Foundry & Engine Co., Sheffield, England.

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When to Weld?

Ed's objection to the purchase of cutting and welding equipment seems to arise from his doubt as to the strength of machines made from welded plates and to the economy of the process. His mind might be set at rest by the statement that a certain maker of crank and toggle presses, some of which are capable of exerting pressures in excess of 700 tons, builds the frames out of plates that are cut and welded together.

From the angle of economy, the frame of a machine built up of welded plates would be considerably lighter than a cast frame. Often the plates for the frame of a machine could be cut out and assembled by welding before the pattern for a cast frame could be made.

Warpage of castings is another point to be considered. While a plate frame will usually retain its shape after being machined, a casting may warp considerably, even after it has been machined.

—Robert Knotek,
Toolroom Foreman, Fisher Body Corporation, Cleveland Division.

Ed's viewpoint regarding flame cutting and welding is unjustifiable. However, it is a common belief by those who have had no experience that flame cutting has a deleterious effect on the metal and that the welding heat causes distortion. Experience has proved that flame cutting has no appreciable effect on either the physical or the chemical characteristics of the low-carbon steels usually used for bed plates and frames of machines. While a thin film of oxide may adhere to the flame cut areas, it can easily be removed.

Some welders put on too much weld metal. This leads to distortion because the more weld metal that is applied the greater will be the resultant heat and, as much of the distortion is due to relief of the initial stresses, the less disturbance by superfluous heat the less will be the warpage.

When it is considered that pattern making and machining are eliminated, the economy of fabrication by cutting and welding plates is obvious.

—A. Eyles,
St. Albans, Hertfordshire, England.

A Step Down

Foremanship is not a position from which one can be demoted without a loss of prestige. A demoted foreman given a job as a journeyman is a liability, as he is not only discontented himself, but he makes others discontented. If a foreman is so unsatisfactory as to warrant demotion, it is best to point out the fact to him and ask him to leave voluntarily, and the management would do well to give him every assistance in getting a new job.

—W. E. Warner,
Orpington, Kent, England.

Yes, Yes!

After a man has been promoted he is approached and treated differently by his subordinates, probably due to their feeling that his increased responsibilities entitle him to more respect, and it is up to them to help him display the dignity to which his new position entitles him.

However fair and sincere the promoted man's intentions were on coming into his higher position, he very soon feels that, although his nature has not been changed, the respect shown him in his new position must have from him at least an outward response. In other words he must not belittle the honor to which he has fallen heir, whether it has come by chance or has been fairly earned.

All the above tends to make "yes" men get along best with some men. Men who can fairly judge matters that originate in other minds against those that originate in their own are few and are entitled to credit beyond which ordinary man can attain.

—John Mark May.

Another Story

There are at the present time too many industrial sites and plants for sale or for rent. Some represent business failures and some represent the former occupants' poor judgment in gaging requirements.

Temporary abundance of profitable orders is too often accepted as an indication of the necessity for immediate expansion. Farming out some of the work to local contract shops would often be the better policy.

For light manufacturing, the multi-story building is the most economical, but the elevators and the staircases should be on the outside. While outside elevators and staircases are more costly than are inside ones, the initial cost will be offset by the advantages, as unbroken lines in the shop lend themselves to uninterrupted passage of material in process.

For heavy manufacturing, the single-story building is the more economical. Where there is a combination of light and heavy manufacturing, the single-story building with an open balcony is probably the best construction. Open-platform elevators or material-handling escalators to serve the balcony are the solution for this type of building, as outside elevators and staircases to serve a single floor would be too costly.

—Ira S. Williams

Manicuring Machines

I don't think that Al's idea of having a skilled man to clean machines would work out very well in practice. Good mechanics will keep the slides and bear-

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ing parts scrupulously clean and well oiled. They will also put paper over the ways of their lathes to keep them free from cast-iron dust and turnings.

When changing from one job to another it is sometimes necessary thoroughly to clean a machine. How I think the advent of a skilled machine cleaner in the shop would have the effect of making the operators more careless about cleaning their machines, knowing that the job has been delegated to someone else. Ordinarily, where one skilled machine cleaner would appear to be sufficient, two or even three might become necessary, making the saving of half an hour of the operators' time per week a doubtful economy. It would seem that an unskilled cleaner could be economically employed to keep the painted parts of machines clean. He would, however, have to be definitely instructed not to brush chips or dirt onto the slides or bearings.

—J. H. Davis.
Wembley, Middlesex, England.

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Pat'd Oct. 19, 1926

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The largest production plants in the United States and Canada—in the most highly competitive industries—buy "Thred-Kut" by the tank car and carload indicating its great utility for all phases of metal cutting.

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new 20-page booklet listing seventeen of the many reasons why this time-tested, yet up to the minute cutting oil will mean increased operating efficiency and increased savings to those plants willing to try it. These reasons are published for the plant manager or plant engineer who wants cutting oil facts.

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Going Places

If additional sales costs were the only added costs incidental to mass production on an item for which the demand is relatively small, the automatic conveyorized layout would be a more rosy proposition universally than it is. The enthusiastic mechanic is particularly likely to make a mistake of that nature, and may run a perfectly sound business venture onto the rocks. Even the finest and most efficient mechanic may be a poor business man. He may be able to detect the slightest inconsistency in mechanical matters and matters of production, yet in the general business view he may fail to see that the wagon is trying to pull the horse.

The cost of distribution increases as much as does the radius of the territory that must be covered to dispose of output. Al never said a truer word than when he declared that it is sometimes smart to stay small. Because of added sales costs, added distribution costs and added overhead in general militating against a business that has been forced into a too-large, top-heavy state, it is often much wiser to have two smaller plants, operating in different distribution territories, than it is to have one larger one. That is one case, believe it or not, where two and two can easily make six in terms of dividends payable.

—John E. Hyler.

Going to Townsend

Al is right in contending that the enactment of the Townsend plan would be destructive to prosperity. Everyone in favor of the plan paints a splendid picture of the good times the old folks are going to have and how it is going to make so much more work for everybody, but they do not mention the enormous tax load that will have to be borne by those who are still working.

The security bill is better, but most states now provide for maximum pensions of $30 per month, which is not enough. Fifty dollars or $60 should be the minimum. Persons should not have to be destitute to qualify for pensions. If they have contributed part of their earnings to the pension fund, they are entitled to pensions, regardless of their incomes from other sources. However, anyone who draws a pension should be required to cease active work.

Any pension plan should be studied very carefully in the endeavor to bring down the cost of administration to approximately what it would be if the matter were handled by a private insurance company. As the set-up is now, the cost will be much too high.

—Thomas M. Garry.

A Long Zip

JOSEPH A. FALK

"Patents and Spray Guns," an item that appeared in *Talking Shop* (*AM*—Vol. 80, page 508), brings to mind a bit of history of what is now known as the zipper.

If memory serves me right, it was in 1904 when a Hoboken, N. J., concern manufactured and marketed what was then known as the "Placket Fastener." It was used by the ladies on the side slits of their skirts; the slide pulled up and was concealed beneath the waist-band. Adaptable to the style then being worn the fastener received a degree of popularity but was gradually abandoned.

Why didn't the idea stick? Simply because toolmaking in that particular branch was not refined enough over 30 years ago. The product looked a little too crude to please milady, and the original company went on the rocks.

They searched for another application of the product where looks did not count so much, and the company tried to have the idea adopted for U. S. mail sacks but failed to put it across.

I lost track of it and completely forgot about the idea for some years when one day I ran across a tobacco pouch with a neat little zipper fastener. Now we have galoshes, shirts, tents, trousers, everything almost, zipper fastened. Perhaps it may be good enough for mail sacks yet.

Flame-Cut Frames For Locomotives

Flame cutting scores another point in its application to locomotive side frames. Frames of small mine or similar locomotives have been cut from slabs for some years. But now one of the large steel companies advertises frames for full size locomotives cut from slabs of any desired length and thickness.

Not only are the frames normalized and tempered after cutting, but nine coupons are cut from different points and tested for bending and tension. Cast steel frames have replaced the old forged frame to a considerable extent. Now castings have a rival in the flame-cut slab frame.

Where Skill Is Needed

Welding, either by arc or torch, offers a great opportunity for individual skill. And the growth of welding depends largely on the increase in the number of skilled welders. In one plant we know of there are approximately 100 welds on each unit turned out, and the number of welds that are defective, in the slightest degree, is under two per cent of the total number of units. This is a small fraction of one per cent when the number of welds are considered.

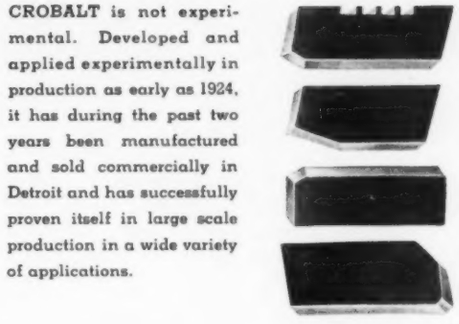
No matter how much experience a welder may have had he goes through a school in the plant before he is placed in the production line in the shop. Here is one place where craftsmanship still has its opportunity.

Welding Is on the March

Australia is going in for welding in a big way. A recent issue of *The Welder*, a British publication, shows six highway bridges with spans up to 122 ft. 8 in. Sleeping cars, including the truck frames, and the welding of a large building for entertainment purposes are also shown, and indicate the growth of welding in England as well. The clang of the riveter is giving way to the sputter of the welder's arc.

"CROBALT"

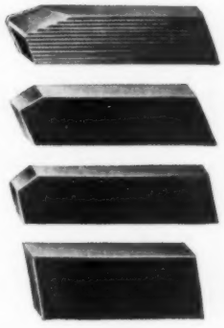
CROBALT is not experimental. Developed and applied experimentally in production as early as 1924, it has during the past two years been manufactured and sold commercially in Detroit and has successfully proven itself in large scale production in a wide variety of applications.



CROBALT is available in the form of both standard and special tools. Its low cost permits the use of solid tools instead of costly tipped types, particularly in the smaller sizes. For forming, CROBALT's high production per grind makes it an ideal cutting metal.

TURNING and FORMING

For such operations as turning, facing, and forming, etc., CROBALT possesses the definite proven advantage of longer tool life per grind—UNAFFECTED by the increased cutting speeds permissible with CROBALT.



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CROBALT's proven 20 per cent longer life (average) per grind as compared with competitive cutting metals has created for it a real place in the milling cutter field.

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TOLEDO, OHIO—W. F. Haverstock
J. W. Mull, Jr.

TRADE PUBLICATIONS

ALLOYS. "Nichrome" and other heat-resisting alloys for mechanical, electrical and chemical purposes manufactured by Driver-Harris Co., Harrison, N. J., are described in a 68-p. book which contains 14 tables of useful data for production men, engineers and other users of alloys.

BEARINGS FOR MACHINERY. An 8-p. supplement to the new production catalog published by Ahlberg Bearing Co., 317 East 29th St., Chicago, has been issued by the company. It shows its lines of Simplex machine units for machine applications. These units eliminate the necessity for machining operations to make proper installations of ball bearings where the bearing housing is either a part of the machine or must conform to the manufacturer's design. It is fully illustrated, and contains convenient tables for installations.

BERYLLIUM COPPER. Heat-treated castings of beryllium copper are explained in a folder issued by Beryllium Corp. of Pennsylvania, Reading.

DRILL GRINDER. Bulletin 115 issued by Black Diamond Saw & Machine Works, Inc., Natick, Mass., describes the No. 1 and No. 2 precision drill grinder, including detailed specifications.

FLEXIBLE SHAFT EQUIPMENT. Swartz & White Mfg. Co., 243 Water St., Binghamton, N. Y., is offering a 32-p. catalog describing its complete line of flexible shaft, cores, cases and equipment.

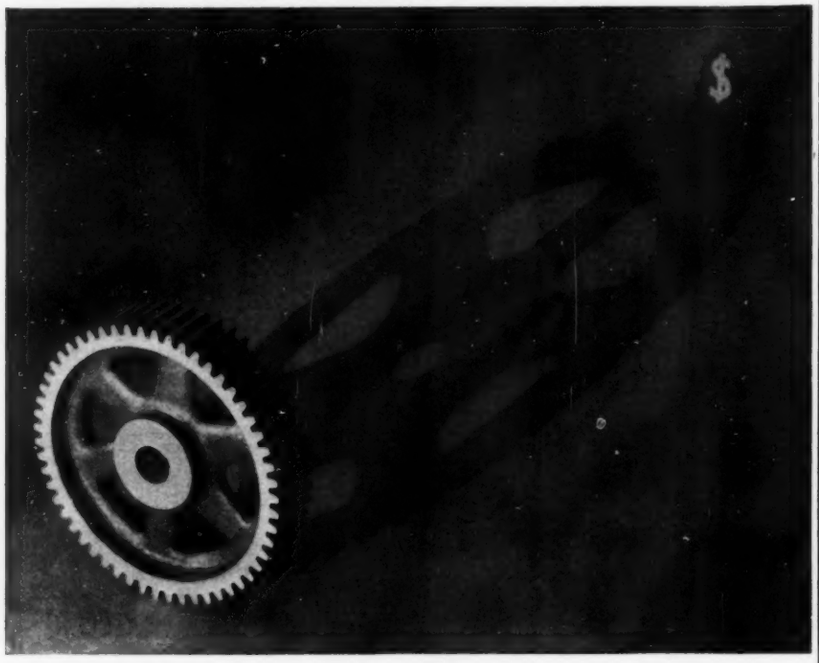
GEAR FINISHING MACHINE. The No. 4 Fellows Enveloping Gear Generator, for finishing spur and helical, external and internal gears, is described and its work explained in a circular issued by Fellows Gear Shaper Co., Springfield, Vt.

GRINDING. A 14-p. section, "A Presentation on Production Grinding," is a feature of the catalog and handbook on grinding just issued by the Hutto Machine division, Carborundum Co., 515 Lycaste Ave., Detroit. The catalog section includes descriptions of the Hutto BS Cylinder grinder, tandem grinder or hone, production grinders and vertical and horizontal honing machines and gear lapping machines.

INSULATING MATERIALS. Industrial insulating materials manufactured by Johns-Manville Corp., 22 East 40th St., New York, are described and amply illustrated in the 1936 edition of the company's "Industrial Products Catalog," now available.

LABORATORIES. A directory of commercial testing and college research laboratories in the United States, with the nature of tests offered, a classification of commodities tested and a geographical listing of the laboratories, has been revised by the National Bureau of Standards and is available from the Superintendent of Documents, Washington, D. C., for 15 cents. Known as Miscellaneous Publication M 125 it supercedes publication M 90.

MAINTENANCE. "Maintenance and Lubrication of Rolling Mill Bearings" is the title of a 20-p. booklet offered by Timken Roller Bearing Co., Canton, Ohio, to anyone interested. It is illustrated with photographs and drawings, and contains four pages of tables of specifications of lubricants for heavy duty roller bearings.



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